SCIENCE

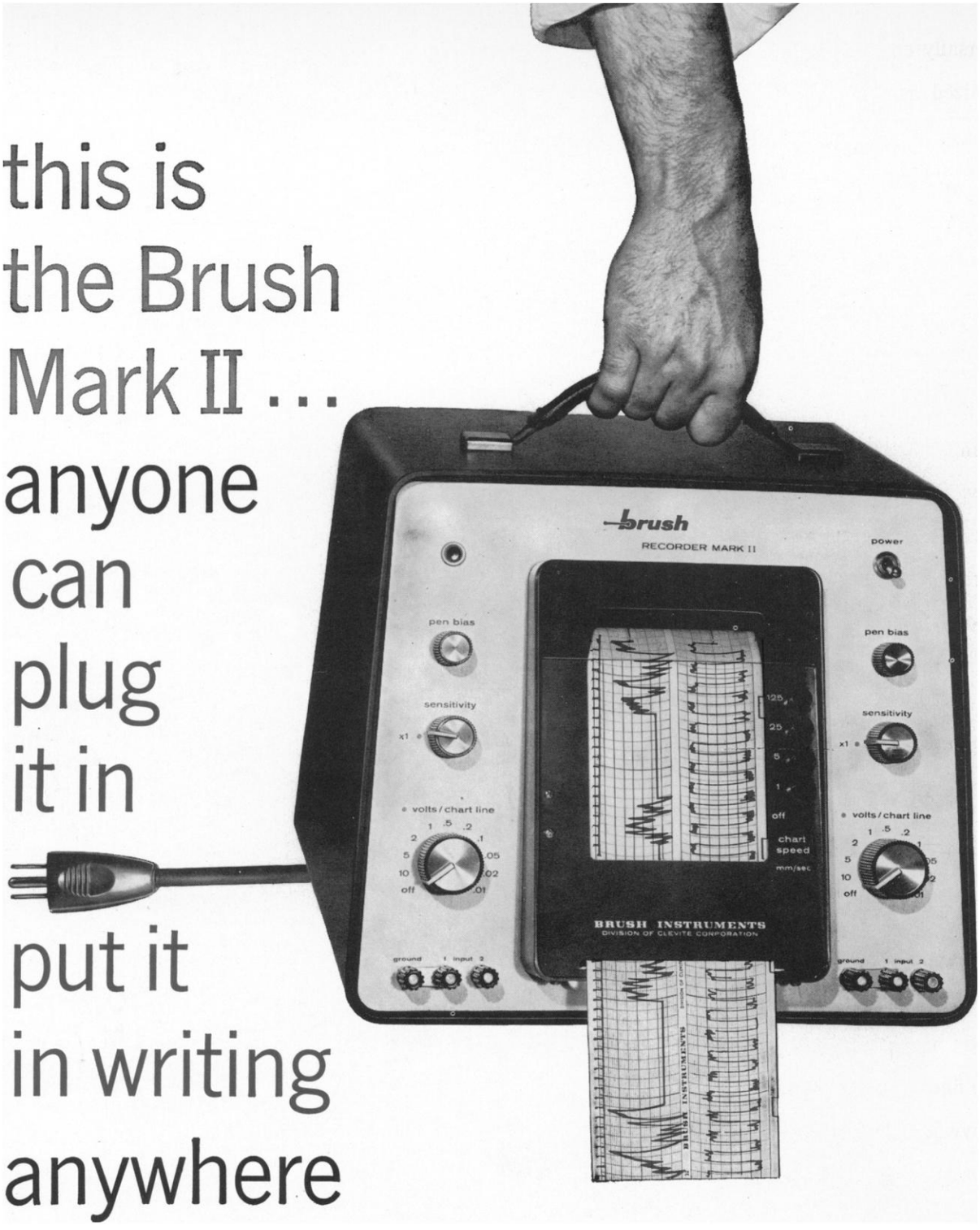
18 January 1963

Vol. 139, No. 3551

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

BOX CANYON

this is the Brush Mark II ... anyone can plug it in put it in writing anywhere



There is no direct writing recorder on the market that approaches the compact Mark II in sheer usefulness. It is a completely integrated engineering tool that can be operated by anyone . . . in the shop or in the field . . . for countless research or design requirements. Every function necessary for uniform, crisp, easily reproduced readouts is "built-in". The Mark II gives you two analog channels plus two event markers; 4 chart speeds; DC to 100 cps response with 40 mm amplitude; 10 mv/mm sensitivity; high input impedance. Ink or electric writing models. Immediate shipment from stock.

brush INSTRUMENTS
DIVISION OF
37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

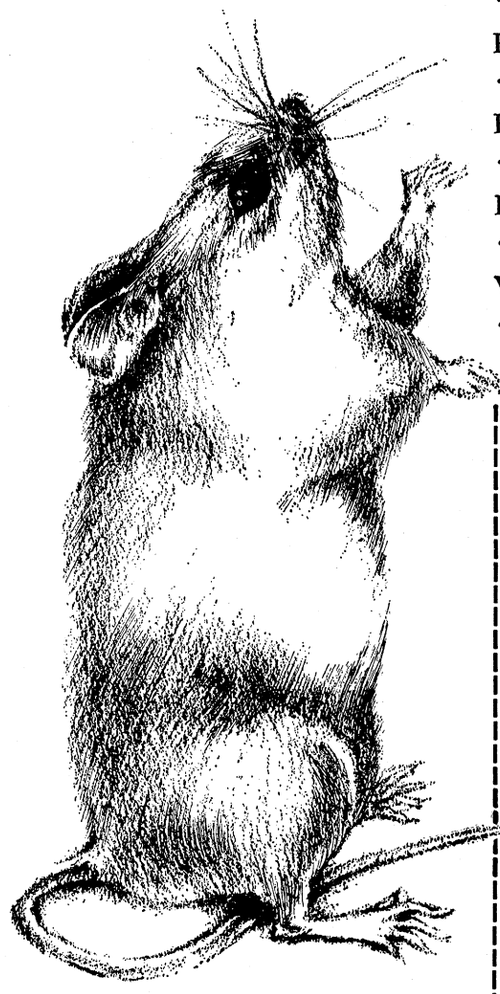
Circle IFC on Readers' Service Card

Universally employed, universally recognized as the leading source of protein nitrogen in vitamin deficiency diet studies . . . hot alcohol-extracted vitamin-free casein from NBCo is exceptionally pure, white, and free of alcoholic odor. NBCo's improved special process . . . with exacting time, temperature and handling controls . . . produces a white vitamin-free casein, the whiteness an immediate indication of the precise care and rigid control of production procedures. Only after meeting extensive biological and microbiological specifications, the final product is released, with detailed assays accompanying each shipment.

SPECIAL OFFER!

NBCo's large-scale production effects dramatic costs savings, so that the finest quality casein available anywhere can be offered at lower prices. Write for details of NBCo's annual quantity price schedule, by which purchasers of 1000 lbs. or more annually may enjoy special volume prices with shipment in lots of 25 lbs. or more.

now... your nutrition studies more rigidly controlled, with IMPROVED PROCESS "VITAMIN-FREE" VITAMIN TEST CASEIN from NBC!



TYPICAL ANALYSIS:

Total Nitrogen (Dry) not less than 14.5%

Total Moisture — maximum.....6.0%

Total Ash — maximum....2.3%

Fat (ether extractables) — maximum 0.01%

pH.....5.85

Lactic Acid does not exceed 0.1%

Thiamine HCl .....0.15 micrograms per gram

Riboflavin .....0.50 micrograms per gram

Niacin .....0.30 micrograms per gram

Pyridoxine HCl .....0.65 micrograms per gram

Pantothenic Acid .....0.15 micrograms per gram

Biotin .....0.0013 micrograms per gram

Folic Acid .....0.030 micrograms per gram

Vitamin B-12 .....0.003 micrograms per gram

NUTRITIONAL BIOCHEMICALS CORPORATION

21010 Miles Avenue
Cleveland 28, Ohio

Send for our free January, 1963 Catalog containing more than 2600 items. Fill out coupon and mail today for your copy.

NAME_____

ORGANIZATION_____

ADDRESS_____

CITY_____

STATE_____ ZONE____

18 January 1963
Vol. 139, No. 3551

SCIENCE

SCIENCE is published weekly by the American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D.C. Now combined with **The Scientific Monthly** ®. Second class postage paid at Washington, D.C. Annual subscriptions $8.50; foreign postage, $1.50; Canadian postage, 75¢; single copies, 35¢. School year subscriptions: 9 months, $7; 10 months, $7.50. Provide 4 weeks' notice for change of address, giving new and old address and zone numbers. Send a recent address label. Opinions expressed by authors are their own and do not necessarily reflect the opinions of the AAAS or the institutions with which the authors are affiliated. Indexed in the **Reader's Guide to Periodical Literature.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., N.W., Washington 5, D.C. Phone: 202-DU 7-7171. Cable: Advancesci, Washington. Manuscripts should be submitted in triplicate, doublespaced throughout. The AAAS assumes no responsibility for the safety of manuscripts. Copies of "Instructions for Contributors" can be obtained from the editorial office.

ADVERTISING CORRESPONDENCE: Room 1740, 11 West 42 St., New York 36, N.Y. Phone 212-PE 6-1858.

COVER

One of the box canyons near Shanidar Cave where animals may have been trapped or kept in prehistoric times. See page 179.

VICKERS BRIEFS

Some Applications of the Cooke-A.E.I. Image-Splitting Measuring Eyepiece

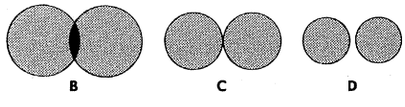
The image-splitting measuring system has been previously described in Cooke Briefs. A prism system moved by a calibrated screw shears the whole microscope field and all details in the field are seen double. Measurement is made by setting double images of objects edge-to-edge, a much more sensitive criterion of measurement than the setting of a filar micrometer reference line. Accuracies up to one-tenth of a micron (0.1μ) can easily be achieved. Reproducibility of measurement is much superior to that possible with conventional systems. Measurement errors due to parallax, thickness of scale lines, lack of rigidity in the microscope assembly, etc., are not possible.

Beyond this there are many special advantages in use which are not possessed by other measuring systems. Some of these are discussed below.

Comparative Measurements

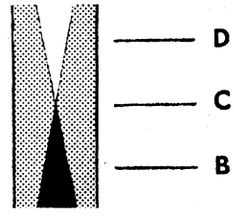
Let these three large dots represent particles of different sizes in a normal microscope field.

Below is shown the same field with double images sheared by a certain amount, as is seen with the Cooke-A.E.I. Image-Splitting Measuring Eyepiece.



Once it is understood that in operation all objects in the microscope field are sheared by an equal amount and that all objects will be examples of double-image types B, C or D, the advantage of the system for comparative measurement can be seen. One measurement might show that all particles whose double images just touch (as in C) are 20μ across in the direction of shear. It is then known, without any measurement, that double images of the B and D types are yielded by particles respectively greater than or less than 20μ.

The image-splitting system is valid for specimens of all sorts — particles, rods or even complete structures such as grids, windings, etc. Suppose that one wishes to check uniformity of width of a fine wire or fiber.



Here the double image would follow a similar scheme to that previously shown for discs. Where the double images are apart the fiber or wire width is shown to be smaller than micrometer shear value; where they touch width is equal to shear and where they overlap width is greater than shear.

Inspection and Go-No-Go Measurements

It can be seen from the above that an amount of shear representing any particular exact dimension can be dialed into the microscope. Thereafter any number of sample preparations can be checked, without further measuring adjustments, for dimensional conformity in the direction of shear.

Measurements of Moving Objects

Since in this system the object is, in a sense, induced to measure itself (i.e., without taking into account reference lines in other optical planes), it can be seen that moving objects are measured as easily and as accurately as stationary ones.

Measurements of Very Small Objects

In conventional measuring systems the width of scale lines and filar wires makes difficult and inaccurate the measurement of very small objects. The image-splitting system of setting double images of the object edge-to-edge operates most effectively in these conditions. Accuracies of up to 0.1μ are easily achieved and the standard of reproducibility is very high.

Measurements in Fluorescent, Polarized Light and Dark Field Microscopy

Oftentimes in using these techniques there is insufficient light to illuminate properly an eyepiece graticule or filar micrometer reference line. However, the performance of the Cooke-A.E.I. Image-Splitting Measuring Eyepiece is unimpaired in these conditions.

•

The image-splitting eyepiece can be used with any microscope having a monocular tube with an unobstructed length of at least 3.6″ from the top. This length is necessary in order to accommodate the tube length compensating system. Price is $490.

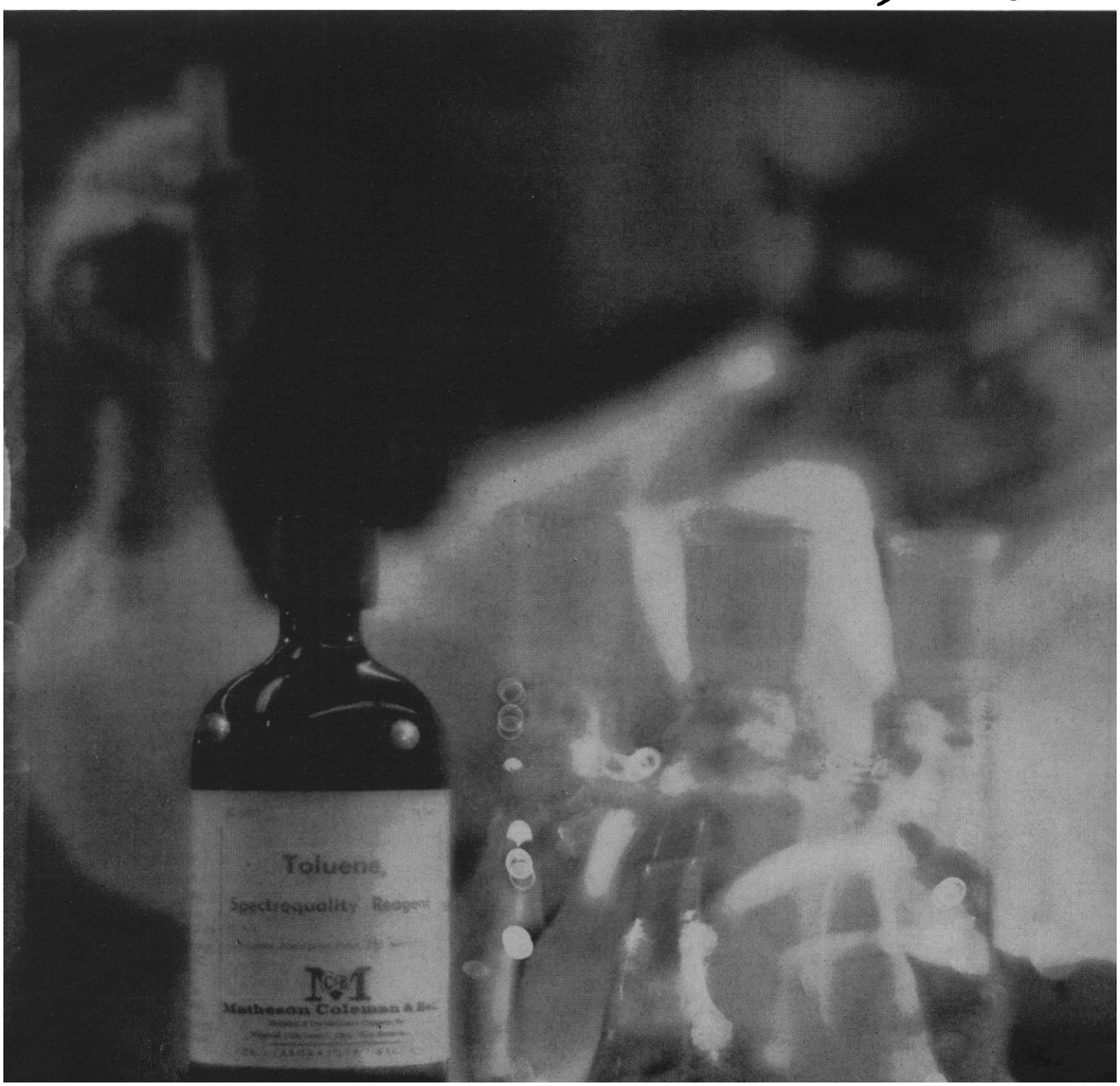
THE MATHESON COMPANY INC. / MATHESON, COLEMAN & BELL DIVISION

East Rutherford, N. J. / Norwood, Ohio / Joliet, Ill. / La Porte, Texas / Newark, Calif. / Whitby, Ontario

The biological chemist explores, not a new continent, but a fraction of a square millimeter in a microscope's field. He seeks, not a mythical Fountain of Youth, but the reality of new drugs and combinations of drugs which will give Man a longer and healthier life. We* proudly salute the biological chemist, a scientist who couples his training and experience with imagination, curiosity, dedication and endless patience in the service of civilization. Like all other great explorers of history, he is a man with the courage to venture into the unknown.

*Matheson/MC&B, modest allies of the biological chemist—supplier of 93 compressed gases and gas mixtures for laboratory use; the nation's fastest growing producer of laboratory chemicals.

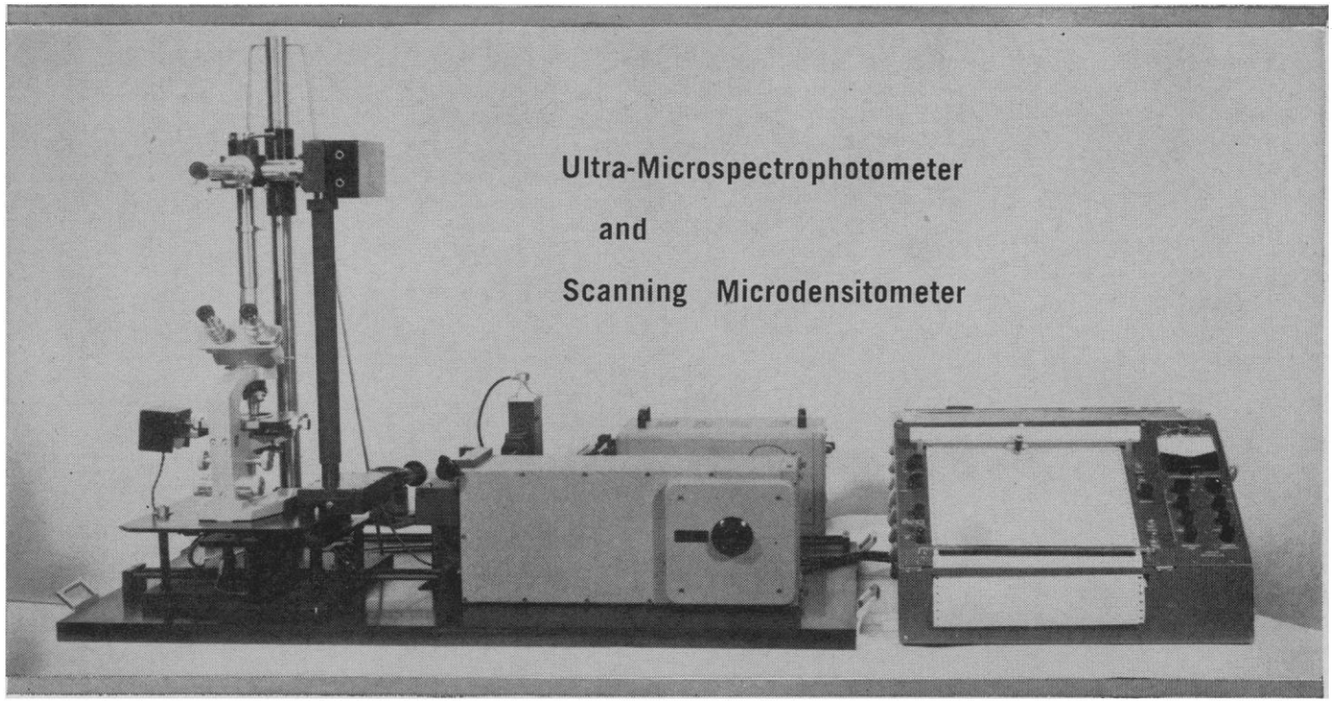
PONCE DE LEON ✣ 1963



NEW FROM CANALCO

UV-VISIBLE ANALYSIS of MICRO-SAMPLES

absorption / emission / interference



Using microscope optics to view the specimen and to collimate the light beam, this versatile dual beam scanning-recording instrument extends the range of spectral analysis and densitometry to microspecimens far beyond the capabilities of previously available equipment. One basic instrument, with appropriate illuminators, optics, stages, accessories, and alternative readout systems, provides for all applications and covers both the U.V. and the visible.

TYPICAL APPLICATIONS

Biochemical
- cytochemical studies
- natural or stained fluorescence in tissues
- clinical colorimetric assays on 5-50 ul volumes
- natural eye pigments
- tissue extracts in picagram droplets
- autoradiographs
- air pollution particles
- micro-electrophoresis strips

Industrial
- diamond crystals
- powder colorimetry
- phosphors
- glass composition
- contaminant particles
- drug reactions
- pigment particles
- fibers and films

Forensic
- blood traces
- paint particles
- tissue particles
- ink analysis

Film Densitometry
- ultracentrifuge U.V. films
- electron micrographs
- diffraction patterns
- micro-electronic circuitry
- aerial photo interpretation

Write for complete details:

CANALCO

Canal Industrial Corporation
4935 Cordell Avenue, Dept. E-13
Bethesda, Maryland

S/P Macroscope System . . .

fills the gap

The S/P Macroscope is a precision optical System that combines true depth of field with comfortable working distances. Designed to fully exploit the myriad possibilities of low power magnification, it guides you through four intermediary ranges with a color-corrected, distortion-free compound optical system. It offers details that are invaluable in selecting material for microscopic findings, in entymology, parasitology, gross cancer biopsies and in many other applications common to your laboratory. Viewing through a five-inch aperture is easy on the eyes, leaves both hands free to handle specimens, dissections, etc. An important advantage of the Macroscope System is its adaptation for photomacrography. An easy-to-use attachment works with any 35mm reflex camera. You really must see the Macroscope in action to fully appreciate the implications of this unique System. Witness how effectively it fills the magnification gap . . . call your S/P Representative for an eye-opening demonstration, or write our Evanston office.

No. M2055—S/P Macroscope (2.5X to 7X).....**$212.00**
No. M2065—Lite-Table.....**$ 75.00**
No. M2057—Camera Mount.....**$ 53.50**

scientific products

DIVISION OF AMERICAN HOSPITAL SUPPLY CORPORATION

GENERAL OFFICES: 1210 LEON PLACE, EVANSTON, ILLINOIS

Regional Offices: Atlanta · Boston · Charlotte · Chicago · Columbus · Dallas · Detroit · Kansas City · Los Angeles
Miami · Minneapolis · New Orleans · New York · San Francisco · Seattle · Washington

Export Department—Flushing 58, L. I., New York. In Canada: Canadian Laboratory Supplies Limited.
In Mexico: Hoffmann-Pinther & Bosworth, S. A.

GET READY FOR THE SPACE and SCIENCE ERA! SEE SATELLITES, MOON ROCKETS CLOSE-UP

AMAZING SCIENCE BUYS for FUN, STUDY or PROFIT

SCIENCE TREASURE CHESTS

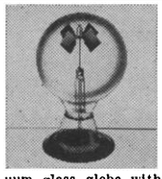
For Boys—Girls—Adults!

Science Treasure Chest — Extra-powerful magnets, polarizing filters, compass, one-way-mirror film, prism, diffraction grating, and lots of other items for hundreds of thrilling experiments, plus a Ten-Lens Kit for making telescopes, microscopes, etc. Full instructions included.
Stock No. 70,342-W ----------**$5.00 Postpaid**
DeLuxe Treasurer Chest,
Stock No. 70,343-W ----------**$10.00 Postpaid**

WHIRLING WONDERS

Wonderful World of Whirling Wheels

Here's a new adventure in optical impressions—created by the magical effect of these fascinating, rotating discs. In addition to weird shapes and fantastic "after images" this kit demonstrates "stop motion" stroboscopic principles—"off center" focus and even hypnotism. Kit includes 13 discs, approx. 5" in dia. battery holder, rheostat, small motor mounted on bracket, bulb, socket, plug and complete booklet of instructions and experimental use.
Stock No. 70,414-W----------**$9.95 Postpaid**



SOLAR MOTOR RUNS AT ASTONISHING 3000 R.P.M.

Powered by light only. Radiometer (solar motor) rotates at up to 3000 R.P.M. in bright sunlight. Also operates with invisible blacklight, even moves from glow of cigarette. Fascinating conversation piece and fine teaching aid. 5" high. 3" dia. vacuum glass globe with 4 rotating vanes.
Stock No. 60,082-W ----------**$1.25 Postpaid**

THERMOMETER TIE BAR AND CUFF LINKS REGISTER AS HOT CONVERSATION PIECE

Ruggedly precise new style item in matched set of cuff links and tie bar—featuring non-breakable, accurately calibrated thermometers. Sensitive to a tolerance of 1 degree (although some wearers have noted violent fluctuations when worn in close proximity to certain blondes and redheads of the warmer sex"). Easy to read. Indicia range from 20 (degrees) to (plus) 120 (degrees) Fahrenheit on circular dial. Silver plated, gift boxed—Tie Bar and Cuff Links also available separately.

Stock No. 1700-W Tie Clasp -------**$3.25 Ppd. tax Incl.**
Stock No. 1701-W Cuff Links -----**$6.55 Ppd. tax Incl.**
Stock No. 1702-W Set of Clasp & Links, $8.75 Ppd. tax Incl.

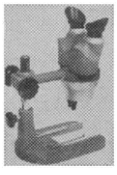
Remove Your Retaining Rings—Disassemble Lenses, Cameras, etc.

ADJUSTABLE SPANNER WRENCH

Made for U. S. Air Force—available at a fraction of Government cost. A top grade, versatile tool that every instrument and camera repair man or just plain tinkerer should own. Adjustable for ½" to 12" diameter retaining rings. Complete with six different pairs of points to fit all types of slots and holes. 3", 6", and 12" main bars. All steel and nicely plated. The finest tool we have ever come across for this type of retaining ring work AND a real bargain at our low price.
Stock No. 70,355-W ----------**$12.50 Postpaid**

American Made — Terrific Buy!

STEREO MICROSCOPE



Years in development. Precision American made. Used for checking, inspecting, small assembly work. Up to 3" working distance. Clear, sharp, erect image. Wide, 3 dimensional field. 2 sets of objectives on rotating turret. 23X and 40X. 10 Days Free Trial.
Stock No. 85,056-W --------**$99.50 f.o.b. Barrington, N.J.**

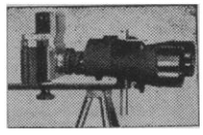
DIRECT MEASURING ATTACHMENT—with regular comparator reticle for on-the-spot checks of linear dimensions, diameters, radii and angles—in millimeters and inches.
Stock No. 40,486-W ----------**$10.00 Postpaid**

DIRECT MEASURING ATTACHMENT—with sand measuring reticle for sand and soil analysis . . . or counting or measuring other particles of matter.
Stock No. 40,487-W ----------**$10.00 Postpaid**

Photographers! This is an actual photograph of the moon taken through our Astronomical Telescope by a 17-year-old student.

NEW BINOCULAR-TO-CAMERA HOLDER

Will Fit Any Camera



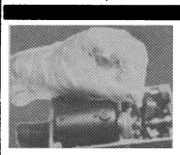
For Exciting Telephoto Pictures. Bring distant objects 7 times nearer with a 35mm camera. 7x50 binocular and our NEW BINOCULAR-TO-CAMERA HOLDER. Ideal for long-range shots of wild life, ships, people, vistas. Camera and binoculars attach easily. Use any binocular or monocular—any camera, still or movie. Take color or black and white. Attractive gray crinkle and bright chrome finish. 10" long. Full directions for taking telephotos included.
Stock No. 70,223-W ----------**$11.50 Postpaid**

MINIATURE WATER PUMP

Wonderful for experiments, miniature waterfalls, fountains, HO gage railroad backdrops, etc. Tiny (2⅝" x 1¾") electric motor and pump ideal for hobbyists, labs, schools. Pumps continuous flow of water at rate of one pint per minute at a 12" head. With 2 D Batteries in series will pump to 24" high. Runs 48 hrs. on battery. Works in either direction. Self-priming.
Stock No. 50,345-W ----------**$2.25 Postpaid**

NEW LOW-COST THROW-AWAY GLOVES!

3¢ to 4¢ Apiece



New, soft, disposable. Great for laboratories, dark rooms, shops, schools, hospitals; for home use—dishwashing, car washing, gardening and hobby work. Made of lightweight polyethelene. Completely waterproof. Resist detergents, solvents, oils, most chemicals. Give excellent protection at lowest cost. Fit either hand. Thin enough for light assembly work, etc.
Stock No. 60,317-W (Package of 100 Medium)--$2.95 Ppd.
Stock No. 60,321-W (Package of 100 Large)---$2.95 Ppd.
Stock No. 60,316-W (Package of 24 Medium)--$1.00 Ppd.
Stock No. 60,320-W (Package of 24 Large)----$1.00 Ppd.

EQUAL-VOLUME SOLIDS

. . . Newest Learning Aid!

Never before available—low-priced equal-volume geometric shapes. Based on basic unit of value—cubic inch. Newest device to help students learn three-dimensional spatial perception. These math and biology aids are valuable for at-desk experiments, homework-play, and science fair projects. Also interesting desk decorations, helpful art aids, etc. Sturdy orange-colored urea plastic. Set contains rectangular solid, sphere, cylinder, cone, sq. pyramid, cube, each displacing 1 cu. in. liquid. Full instructions include suggested experiments. Imported.
Stock No. 60,250-W—One Set----------**$ 2.50 Pstpd.**
Stock No 70,584-W—Pkg. of 10 Sets----**$22.50 Pstpd.**

MAT ALARM—

NEW SIGNALING DEVICE FOR HOME, STORES AND OFFICES

Mat Alarm and Signaling Device, 3/32" thick x 17" x 23", detects presence of anyone entering a home, store or office. May be used as burglar alarm, entrance signal in small stores, professional offices, provide front and back door illumination for private homes, etc. It may be placed under rugs or other floor covering at entrances or below windows. Pressure of 5 lbs. or more on any part of mat actuates low-voltage bell or buzzer, or lights an electric bulb. Switching elements electronically sealed between sheets of tough vinyl. Transformer to step down voltage to proper level for alarm or signaling circuit included. Bell or other alarm device may be obtained locally.
Stock No. 70,591-W.....**$10.75 Postpaid**

CONSTANT-SIGNALING DROP RELAY activated by pressure on mat is optional. This keeps alarm on until manually reset.
Stock No. 40,592-W.....**$7.50 Postpaid**

See the Stars, Moon, Planets Close Up!

3" ASTRONOMICAL REFLECTING TELESCOPE

Study Venus—the brightest star Probed by Mariner II Spacecraft
60 to 180 Power. An unusual Buy! Famous Mt. Palomar Type

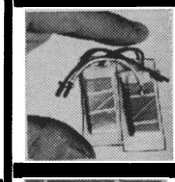
You'll see the Rings of Saturn, the fascinating planet Mars, huge craters on the Moon, Phases of Venus Star Clusters, Moons of Jupiter in detail. Galaxies! Equatorial mount with lock on both axes. Aluminized and over-coated 3" diameter high-speed f/10 mirror. Telescope comes equipped with a 60X eyepiece and a mounted Barlow Lens, giving you 60 to 130 power. An Optical Finder Telescope, always so essential, is also included. Sturdy, hardwood, portable tripod—**FREE with Scope:—Valuable STAR CHART plus 272 page "HANDBOOK OF HEAVENS" plus "HOW TO USE YOUR TELESCOPE" BOOK.**
Stock No. 85,050-W ----------**$29.95 Postpaid**

4¼" Astronomical Reflector Telescope!

255 Power. New Vibration-Free Metal Pedestal Mount.
Stock No. 85,105-w ----------**$79.50 F.O.B**

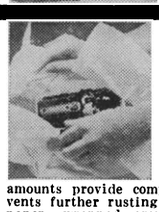
SUPERB 6" REFLECTOR TELESCOPE

INc. electric clock drive, setting circles, equatorial mount, pedestal base. 4 eyepieces for up to 576X.
Stock No. 85,086-W----**$195.00 F.O.B. Barrington, N.J.**



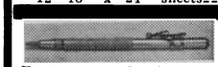
INSTANT ELECTRICITY with SUPER-POWER WET CELL BATTERY

Packs power galore, yet weighs only 15 grams. Learn—demonstrate electro-chemistry, run small aircraft motors, etc., with fascinating postage-stamp size battery. One-time use. Activated by adding brine. Stores indefinitely. 1.1V per cell. **Stock No. 40,590-W Set of 10..$2.00 Postpaid**



VPI—NEW RUSTPROOFING CHEMICAL—Boon to Industry and Home Craftsmen

Quick, easy, foolproof. Eliminates messy greasing and oiling of tools, metal parts, etc. When applied, VPI—Vapor Phase Inhibitor—forms thin, invisible coating on metal surfaces. Comes in two forms—VPI Crystals, VPI Paper. Crystals dissolve in water or alcohol. Small amounts provide complete rust protection. VPI also prevents further rusting where rust has begun to form. VPI paper, wrapped around metallic items, slowly releases rust-inhibiting chemical to form protective coating.
Stock No. 40,596-W Crystals, 1 oz.------**$ 1.50 Postpaid**
Stock No. 60,319-W Crystals, 1 lb -----**$15.00 Postpaid**
Stock No. 60,318-W Paper, 12—18" x 24" sheets----------**$ 2.00 Postpaid**



CARBIDE-POINTED SCRIBER—CUTS LIKE A DIAMOND

Engraves metal, glass, gems, ceramics, plastics. Perfect tool for craftsmen, die-cutters, designers, jewelers, hobbyists. Pen shaped for accurate guidance—5½" long—with pocket clip. Replaceable carbide tip can be recessed to prevent damage to tip and clothing. Comes with magnet for retrieving small metal parts.
Stock No. 40,594-W----------**$1.75 Ppd.**
Stock No. 40,595-W Replacement Tip-----**$1.00 Ppd.**

NEW LOW PRICE FLASHLIGHT POINTER

. . . Point It Out With Arrow Projected

Ideal for pointing out interesting features on movie and slide projection screens. Excellent lecture tool. For teacher use on maps, etc. Flashlight focuses an arrow where you point it.
Stock No. 60,117-W ----------**$6.95 Postpaid**

New Zoom Microscope Eyepiece ZOOMS Powers From 30X to 2000X

Greatest microscope accessory yet! Priced amazingly low. Combines all eyepiece powers from 10X to 20X in one assembly. Twist of dial . . . without more focusing . . . without extra eyepiece changing . . . and you command powers up to 2000X. Professional all-metal quality construction, heavily plated, anodized. Fits any standard .917" dia. microscope tube. Built-in, adjustable clamping ring insures tight, mar-free attachment. Stops eyepiece changing. Coated elements, 2¾" lg., 1½" max. dia., 5 oz. wt.
Stock No. 60,270-W ----------**$25.00 Pstpd.**

MAIL COUPON for FREE CATALOG "W"

NEW! 1,000'S OF BARGAINS
164 PAGES

EDMUND SCIENTIFIC CO.,
Barrington, New Jersey

Please rush Free Giant Catalog-W

Name .....

Address .....

City .....Zone.....State.....

ORDER BY STOCK NUMBER . . . SEND CHECK OR MONEY ORDER . . . SATISFACTION GUARANTEED!

EDMUND SCIENTIFIC CO. BARRINGTON, NEW JERSEY

Recent AAAS Symposium Volumes

#72. **Spermatozoan Motility.**

1962. 322 pages. 113 illustrations.
Edited by: David W. Bishop.
For the first time the details of sperm motility are here presented in monograph form. A wealth of previously unpublished data. A valuable souce of reference for the student and investigator, as well as for the practitioner of applied reproductive biology.

Retail Price: $7.50. *AAAS Member's Cash Price*: $6.50.

#71. **Great Lakes Basin.**

1962. 320 pages. 92 illustrations.
Edited by: Howard J. Pincus.
The reader will find here material on pure and applied science, accounts of new research and reviews of material published elsewhere, historical and social studies, and pleas for action and planning.

Retail Price: $7.50. *AAAS Member's Cash Price*: $6.50.

#70. **Fundamentals of Keratinization.**

1962. 202 pages. 136 illustrations.
Edited by: Earl O. Butcher and Reidar F. Sognnaes.
The fields of anatomy, dentistry, dermatology, medicine, pathology, and zoology are represented in this volume.

Retail Price: $6.50. *AAAS Member's Cash Price*: $5.75.

#69. **Biophysics of Physiological and Pharmacological Actions.**

1961. 612 pages. 212 illustrations.
Edited by: Abraham M. Shanes.
A bird's-eye view of a number of principles now considered important. Useful for teaching, as well as for research purposes.

Retail Price: $13.50. *AAAS Member's Cash Price*: $11.75.

#68. **Sciences in Communist China.**

1961. 884 pages. 23 illustrations.
Edited by: Sidney H. Gould.
". . . strongly recommended to all who are in search of facts and source material on the sciences in China."—*Science*, 22 September 1961

Retail Price: $14.00. *AAAS Member's Cash Price*: $12.00.

#67. **Oceanography.**

1961. 2nd printing, 1962. 665 pages. 146 illustrations.
Edited by: Mary Sears.
"I know of no other volume that so well defines oceanography, its purpose, opportunities and requirements."—*Science*, 9 June 1961

Retail Price: $14.75. *AAAS Member's Cash Price*: $12.50.

#66. **Germ Plasm Resources.**

1961. 394 pages. 59 illustrations.
Edited by: Ralph E. Hodgson.
"This book will be of interest to nonplant and animal breeders, for the rather general treatment of various topics . . . allows for rapid perusal."—*Bulletin of the Entomological Society of America*, September 1961

Retail Price: $9.75. *AAAS Member's Cash Price*: $8.50.

#65. **Aging . . . Some Social and Biological Aspects.**

1960. 436 pages. 65 illustrations.
Edited by: Nathan W. Shock.
"The 26 contributors include many of the most respected names in American gerontology, and the chapters cover a wealth of material."—*Journal of Gerontology*

Retail Price: $8.50. *AAAS Member's Cash Price*: $7.50.

#64. **Calcification in Biological Systems.**

1960. 526 pages. 283 illustrations.
Edited by: R. F. Sognnaes.
"Those interested in current concepts of mineralization of calcified tissues will find in this text the sources of current knowledge on the subject."—*American Journal of Orthodontics*, May 1961

Retail Price: $9.75. *AAAS Member's Cash Price*: $8.50.

#63. **Congenital Heart Disease.**

1960. 372 pages. 147 illustrations.
Edited by: Allan D. Bass and Gordon K. Moe.
"Should serve as a valuable and concise summation of the more important aspects of congenital heart disease."—*American Journal of Cardiology*, August 1961

Retail Price: $7:50. *AAAS Member's Cash Price*: $6.50.

British Agents: Bailey Bros. & Swinfen, Ltd., Hyde House, West Central St., London, W.C.1

Clip out this Form. Fill in and Mail Today

Circle Volumes You Wish To Order . . .

72	71	70
69	68	67
66	65	64
63		

$.....

Payment Enclosed

American Association for the Advancement of Science
1515 Massachusetts Avenue, NW
Washington 5, D.C.

Please send the symposium volumes circled on this form, to:

Name: .....

Address: .....

City: ..... Zone: ..... State: .....

Please check:

( ) I am a member of AAAS, and enclose payment for the volumes indicated at member prices. ( ) $.....enclosed.

( ) I am not a member of AAAS. ( ) Please bill me.

( ) Please send Membership Application Form.

NO KNIFE EDGES IN NEW

OPTICAL PROJECTION TORSION BALANCE

By eliminating knife edges with Torsion's practically one-piece construction, Model PL-2 is designed to operate even in severely corrosive or dust-laden atmospheres where maintenance costs for ordinary "knife-edge" balances would be prohibitive. ● The long lasting accuracy of this Torsion construction, with Dynavar bands, has been proved by a testing device that made continuous weighings 24 hours a day for six months. Over 1,750,000 operations later the Torsion mechanism still had its original sensitivity and accuracy.

Model PL-2
Capacity 2000 g. • Accuracy ± 0.15 g.
List Price $425

ADDITIONAL FEATURES

True Weight even when out of level

Zero point does not shift even when balance has been moved to a position that is out-of-level.

Weight Loading

Weight loading knobs are conveniently located on both sides of the balance for easy operation by either right or left hand. Weighing by substitution to 1000 grams is used in this New Torsion Laboratory Balance.

Unlimited Tare Range

Taring through a 125 gram range is accomplished with a built-in knob on the side of the balance. By adding weights to the second pan the balance can be made to tare throughout its 2 kilogram capacity.

In addition to these features, Torsion's Model PL-2 offers a sharp image with a high degree of illumination for easy reading and an oil damper to speed up weighing.

Ask your laboratory supply salesman for a demonstration or write us for Bulletin PL-2 which gives complete specifications.

The **Torsion Balance** *Company*

Main Office and Factory: Clifton, New Jersey
Sales Offices: Chicago, Ill., San Mateo, Cal.

LABORATORY INTERFEROMETER

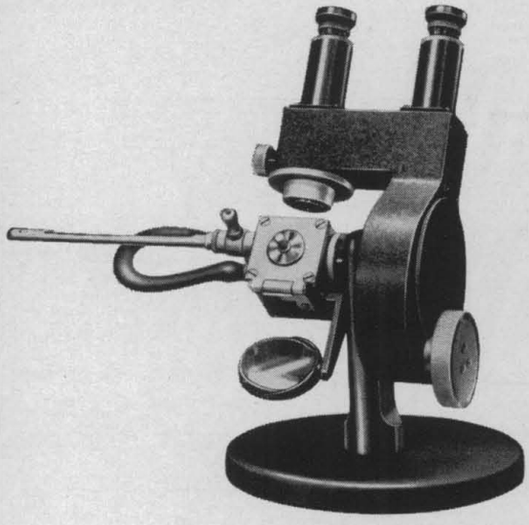
For concentration measurements of solutions and gaseous mixtures. Numerically determines refraction value differences against comparison standards. This extremely easy-to-use instrument develops a higher order of accuracy than any other of its type.

- Liquid examination applications . . . water examination institutes; oceanographic studies; food product testing; medical, pharmacological, and physiological institutes; plastic and textile industry
- Gaseous examination applications . . . gas industry; mining; rubber and linoleum factories; incandescent lamp manufacture; hospitals and tuberculosis clinics; physical, physico-chemical and chemical institutes

TECHNICAL DATA

Range of measurement —
5 to 5000 units of the fifth decimal of the refractive difference Δn, subdivided according to the length of chamber

Limit of error —
± 2 units of the eighth decimal to 2 units of the fifth decimal of the refractive difference Δn, likewise in accordance with the length of the chamber



ABBE REFRACTOMETER

This newly designed instrument measures the refractive index of liquids, fats and oils as well as plastic and solid materials.

- Interchangeable prism casing with insulated lock
- Easier reading and increased measurement accuracy
- Safe, dust-proof scale housing
- Pinion head conveniently positioned for easy manipulation of border line setting
- Adjoining scales for refractive index and dry substance
- Measurements with higher or lower temperatures

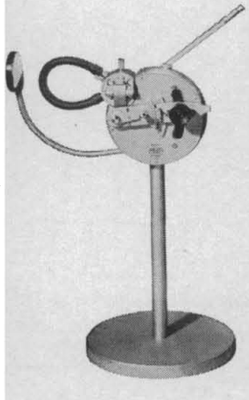
TECHNICAL DATA

Range of measurement —
Refractive index $n_D = 1.3$ to $n_D = 1.7$
Dry substance 0 to 85%

Limit of error —
Refractive index ± 1 to 2 units of the fourth decimal
Dry substance ± 0.1 to 0.2%

CARL ZEISS JENA

companion of scientific progress for six generations



FOOD PRODUCTS (SUGAR AND OIL) REFRACTOMETER

This precision production control and laboratory instrument is designed for rapid tests in series to determine dry substance or water content.

- Surface of double prism opens horizontally to facilitate filling with sample
- Easy to manipulate
- Fast, accurate measurements
- Economical use of test material

TECHNICAL DATA

Range of measurement —
Dry substance 0 to 95%
Refractive index $n_D = 1.300$ to 1.540

Limit of error —
Dry substance ± 0.1 to 0.2%
Refractive index ± 1 to 2 units of the fourth decimal

DIPPING REFRACTOMETER

This is the most accurate of all refractometer instruments. A complete range of ten heatable and ten non-heatable prisms permits rapid analysis, even at high temperatures. Boundary line position is read from scale containing 110 divisions. Readings can be made to one-tenth of a scale division by means of a micrometer screw.

TECHNICAL DATA

Range of measurement — 1.3254 to 1.6470
Limit of error — ± 2 units of the fifth decimal of the refractive index

Complete information may be obtained from your local Carl Zeiss Jena instrument dealer or by writing: Dept. SI/63

ERCONA Ercona Corporation, Scientific Instrument Division, 16 West 46th Street, New York 36, N.Y.
In Canada: Jena Scientific Instruments Ltd., 1437 MacKay Street, Montreal, Quebec

Are you using your Most Expensive Scientific Equipment Efficiently?

If you consider the time you spent in preparing it your most expensive equipment is the personal abstract or data file you have been compiling for years. More likely than not this exists on 3 x 5 index cards which you have filed one way, and searches for special articles or correlations are very time consuming.

With the edge notched PMU cards which we sell you can convert your present file, even without retyping, and from then on record your new abstracts directly on our standard abstract cards. These edge notched PMU cards hold more information than standard tabulating cards and require no electronic equipment. The sorting rate is conservatively 11,000 columns per minute because they sort in 28 locations at once at more than 400 cards per minute.

The saving is immediately apparent. There is no monthly rental on the equipment and the job is more efficiently handled than with an 8000 dollar sorting installation because the cards are designed for the complexity and relatively small size of the usual personal abstract file.

Conversion requires no extra typing. If you want to your present cards can be attached to the standard PMU cards or the data can be transferred directly on a Xerox machine.

The next step is to establish a code for punching the data around the edge of the cards. We will supply a free coding analysis with all Master Units if you give us the information listed on the coupon below.

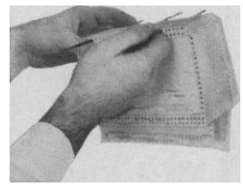
We have also provided a more detailed analysis of procedures in a Special Booklet titled: Scientific Uses of Punched Cards. Send for it with the coupon below or the magazine's inquiry card.

Low Installation Cost

A crucial part of any decision to install a data retrieval system is: How Much Will it Cost to Install and Maintain? The installation cost properly includes the expense of transcribing data into the new procedure. With our standard PMU cards (5x8 inches with 88 holes around the edges) the data can be typed on the surface, pasted on as abstracts from journals or in the case of smaller articles pasted right on the card. Larger cards are available on special order for any purpose with printing if required. We have found that most customers are satisfied with the standard cards.

Coding of the cards is extremely simple using a random overlapping code for the basic categories you choose for each item. Once you have checked off the phrases or numbers coding proceeds by notching the cards around the edge at the appropriate numbers. This work is readily delegated to non-trained clerical personnel as is the sorting procedure. You do not need specially trained operators for our equipment.

Cards once used do not have to be replaced in order. Just drop them back, after use, anywhere. The file is immediately available for reuse. This, by the way, avoids the terrible danger that a card, through misfiling, will be permanently unaccounted for in routine searches.



Cards are readily sorted by hand rods.

USERS *(partial list)*

Industrial Firms

General Electric	Borden Chemical Co., Inc.
Sylvania Electric	Equitable Life Insurance
Kintel Electronics	Westinghouse Electric
Mobil Oil	Ling-Temco-Vought

Institutions and Laboratories

Franklin Research Institute	National Institute of Health
Bureau of Engraving and Printing	US Forest Service
US Naval Aviation Medical Center	US Naval Propellant Lab
	Veterans Hospital Dearborn Michigan

Schools and Universities

Johns Hopkins University	Northwestern University
Columbia University	University of Adelaide
University of Minnesota	Dartmouth College
Western Reserve University	Temple University

and hundreds of other institutions and organizations

FREE Coding Analysis

To help you get the most out of your PMU data file we will provide a free analysis of your data system to recommend the most efficient coding procedure. In addition to the specific items listed below we would appreciate a sample of your present card if it is printed and a full description of what you are putting in and what you expect to get out of the files.

Please be sure to list the following:

- **Total Number of Basic Categories**
- **Subheadings (total)**
- **Frequency of searches**
- **Estimated present size of file**
- **Growth Rate per year**
- **Who will make searches? Professional or secretary?**
- **Field of research**
- **Are you recording original data or just abstracts?**

Highly efficient

Information retrieval systems for personal use or small card files are usually expensive, cumbersome, and require special personnel to reprogram the sorting procedures. The Geniac Portable Memory Unit is suited particularly for files of 1000-10,000 where low installation costs and maintenance by office personnel are highly desirable features. Sorting equipment is simple but effective so that there can be no need for outside repairment or service.

Furthermore sorting rates are conservatively 400 per minute with simultaneous sorting in 25 categories at once. Procedures with other equipment of this speed require one sort per category. Our PMU therefore reduces the time you have to spend waiting for the retrieval sort to be made.

Chances are that your abstract file is just the same as it would be in the lab of an eighteenth century scientist. You put the articles into files by authors or by categories; abstracts are kept the same way. But did you know that for no extra cost you can keep articles and abstracts on file in up to ten thousand categories at once? Think of the possibilities this creates for cross correlating raw data, or bringing together papers that incidentally touch on related subjects.

Free Inspection Offer.

There is no charge for you to inspect our system. So why don't you try this inexpensive simple method for improving your own data file today. Elsewhere on this page we have a list of firms, institutions and government offices that have ordered and are using our PMU system. We are pleased, too, that every day we receive reorders for more cards to expand their files and for new basic sets so that their associates and friends can get their research done more efficiently.

To buy decide on the initial offer you want and send us an order on your institutional purchase forms; if you want just clip out the coupon below and send it in. Your order will be filled promptly from stock on the same day received.

Each basic kit contains instructions for coding the cards to achieve optimum efficiency. We are glad to provide at no extra charge advice on coding procedures for your particular research application.

Oliver Garfield Co., Inc.

Rm. 13, 17 St. Marks Place, New York 3, N. Y.

Please reserve a GENIAC Portable Memory Unit in my name for immediate delivery. I wish to order with it the following equipment:

☐ Basic PMU, with 200 punched cards, hand notching tool, 5 sorting rods, Coding Instructions @ $19.95 _____
add 80¢ post and handling _____
_____

☐ Master PMU including Basic Unit above plus 1,000 extra cards and free filing cabinet @ $49.95 _____
add $4.75 per unit balance refunded, post and handling

☐ Cabinet alone @ $8.00 plus 1.00 postage and handling
Additional cards @ $4.00 per hundred or $30.00 per thousand. _____
add 30¢ postage per hundred cards _____

☐ Send additional information and booklet Scientific Uses of Punched Cards.

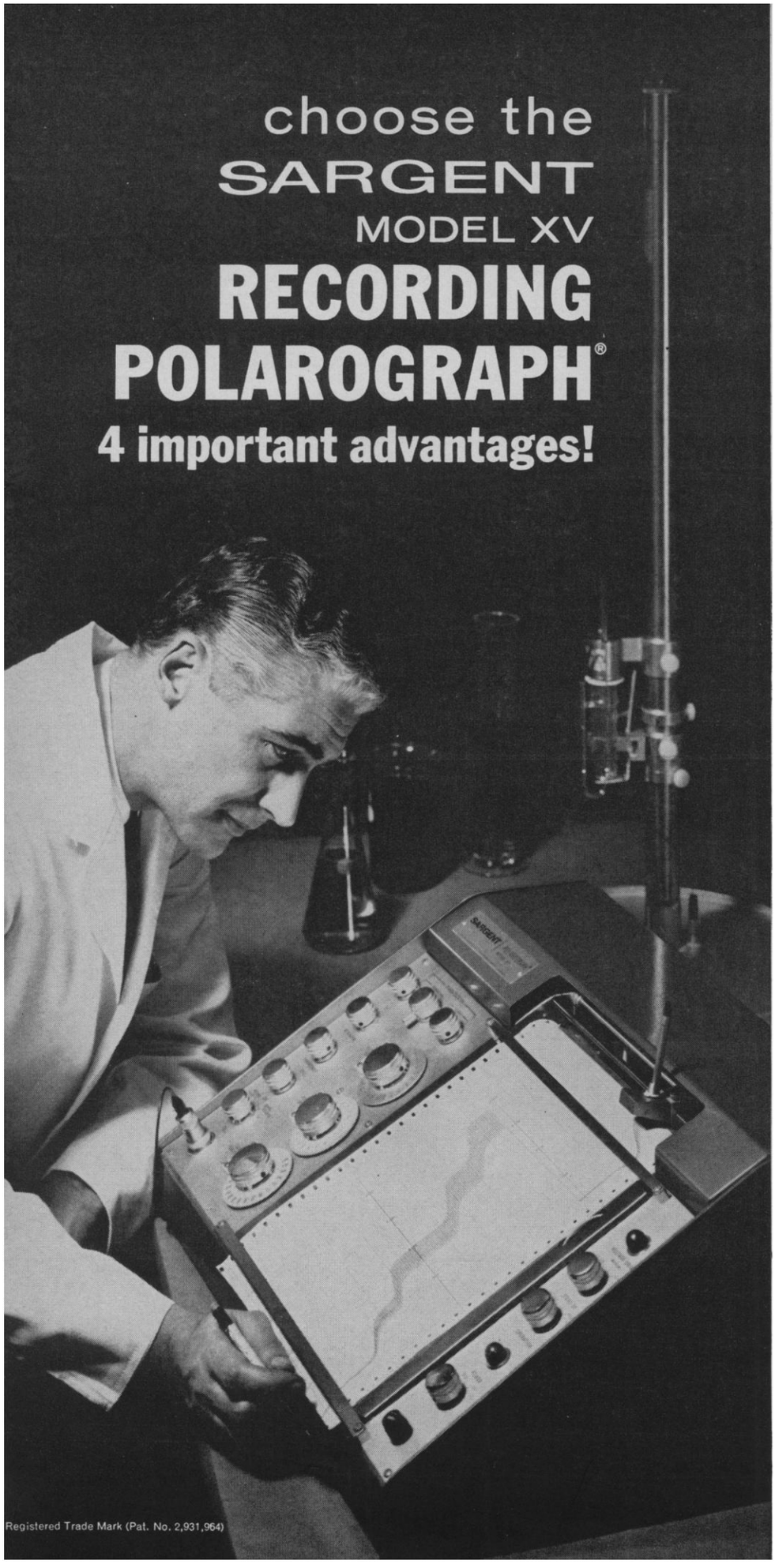
I enclose my check or money order for .....$_____

I understand that if I do not find the GENIAC Portable Memory Unit all that you have said it is I may return the entire unit and the cost of the unit will be refunded.

Name_____

Address_____

City_____ Zone____ State_____



1. Full 10″ Chart

2. 1/10% Accuracy of Measurement

3. 10 Standardized Polarizing Ranges

4. Low Cost

This Sargent POLAROGRAPH gives you a large 250 mm (10 inches) chart and the highest accuracy and current sensitivity at the lowest price of any pen writing polarographic instrument meeting these specifications.

It offers you optimum specifications based on over twenty years of leadership in design, manufacture and service in this specialized field of analysis.

The polarographic method is capable of reproducibility to 1/10% and analytical accuracy to ½%. To make use of this facility, the instrument must be accurate to 1/10% and chart space must be provided for recording large steps to achieve measuring precision. We strongly advise against the purchase of any polarographic instrument using miniature (5 inch) charts and low gain balancing systems in the 1% order of precision.

This Model XV is adaptable to 10^{-6}M determinations with the S-29315 Micro Range Extender.

SPECIFICATIONS

Current Ranges: 19, from .003 to 1.0 μA/mm.

Polarizing Ranges, volts: 0 to -1; -1 to-2; -2 to -3; -3 to -4; +.5 to -5; 0 to -2; -2 to -4; +1 to -1; 0 to -3; +1.5 to -1.5.

Balancing Speed: standard, 10 seconds; 1 second or 4 seconds optional.

Bridge Drive: synchronous, continuous repeating, reversible; rotation time, 10 minutes.

Chart Scale: current axis, 250 mm; voltage axis, 10 inches equals one bridge revolution.

Current Accuracy: 1/10%

Voltage Accuracy: ¼%

Chart Drive: synchronous, 1 inch per minute standard; other speeds optional.

Writing Plate: 10½ x 12½ inches; angle of slope, 30°.

Standardization: manual against internal cadmium sulfate standard cell for both current and voltage.

Damping: RC, four stage.

Pen: ball point; Leroy type optional.

Suppression: zero displacement control, mercury cell powered, 6 times chart width, upscale or downscale.

Potentiometric Range: 2.5 millivolts, usable as general potentiometric recorder.

Finish: case, enameled steel; panels, anodized aluminum; writing plate, polished stainless steel; knobs and dials, chromium plated and buffed.

Dimensions: 23 x 17 x 10 inches.

Net Weight: 65 pounds.

S-29310 Sargent Model XV Recording Polarograph with accessories and supplies.....$1585.00

For complete information write for Sargent Bulletin P.

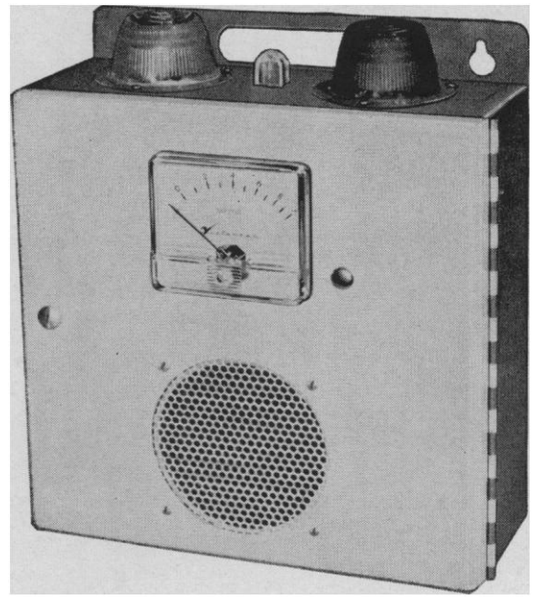
E. H. SARGENT & CO., 4647 W. FOSTER AVE., CHICAGO 30, ILLINOIS
Detroit 4, Mich. · Dallas 35, Texas · Birmingham 4, Ala.
Springfield, New Jersey · Anaheim, California

SARGENT

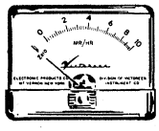
Scientific Laboratory Instruments
Apparatus · Supplies · Chemicals

TRANSISTORIZED VICTOREEN VAMP

gives dependable,
continuous monitoring
to comply with
tighter AEC standards

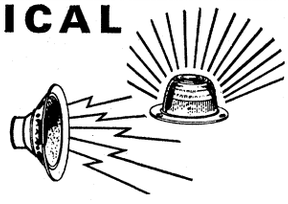


PRACTICAL

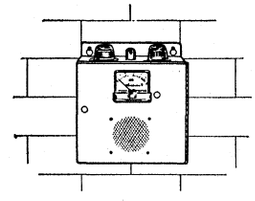


Indicates beta-gamma — full scale ranges of 0-10 or 0-50 mr/hr.

Internally adjustable alarm point, from 20 to 100% full scale, prevents unauthorized tampering.



Presettable visual and audible alarm system.

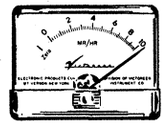


Easily installed. Can be mounted to wall, used on table top or transported to any location.

FAIL-SAFE

White pilot light shows if A-C power is On.

Amber failure light indicates when instrument is not continuously reading built-in check source.



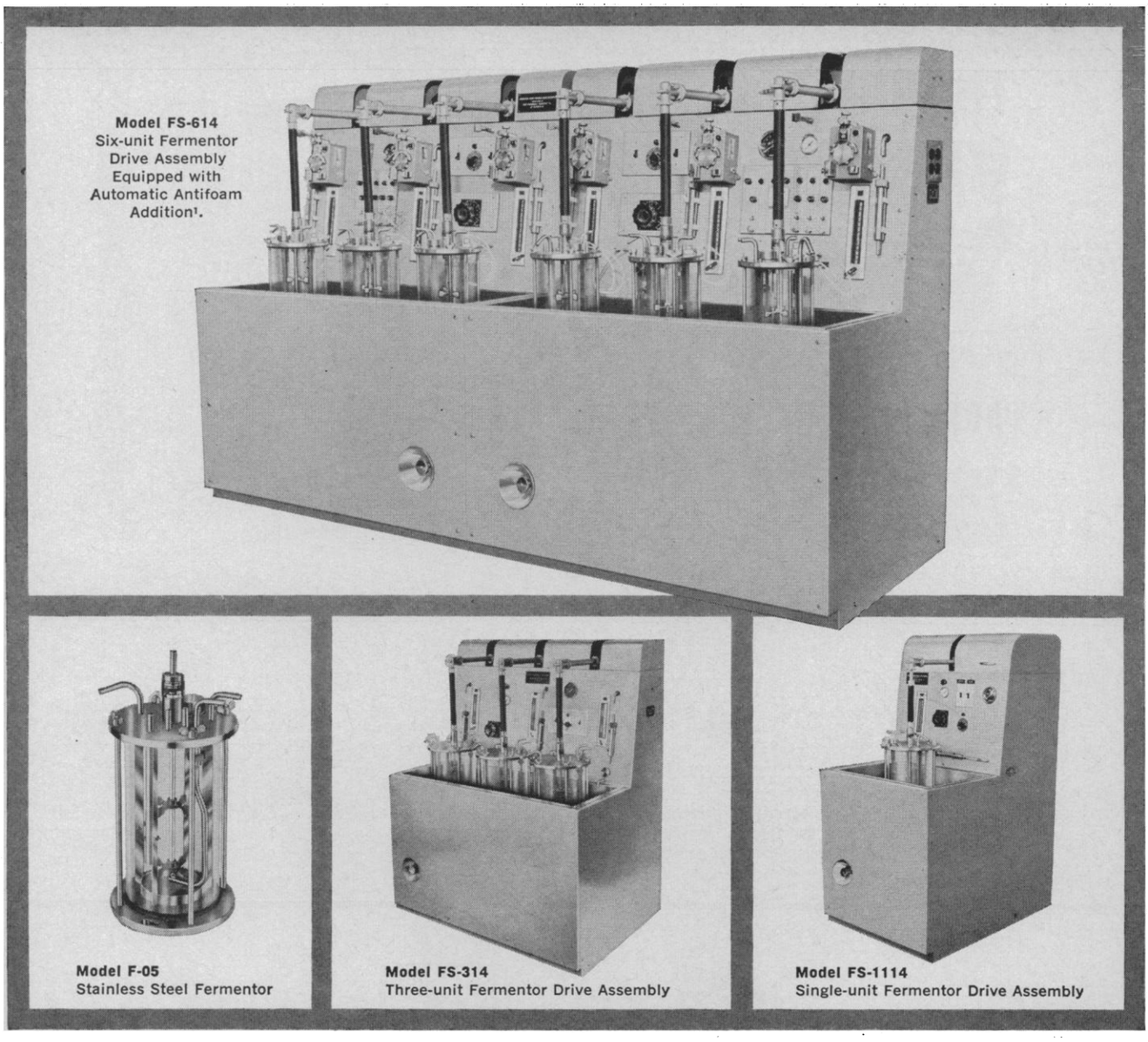
No blanking out in high radiation. Meter pins at full scale and alarms properly.

Bright flashing red alarm light.

VICTOREEN
WORLD'S FIRST NUCLEAR COMPANY

THE VICTOREEN INSTRUMENT COMPANY
5806 HOUGH AVENUE • CLEVELAND 3, OHIO
Victoreen European Office: The Hague

A-6826A



Model FS-614
Six-unit Fermentor Drive Assembly Equipped with Automatic Antifoam Addition[1].

Model F-05
Stainless Steel Fermentor

Model FS-314
Three-unit Fermentor Drive Assembly

Model FS-1114
Single-unit Fermentor Drive Assembly

NBS FERMENTATION APPARATUS for the growth of Bacteria, Fungi, Yeasts, Tissue Cultures and Viruses

For Aerobic and Anaerobic Studies of Microbial and Chemical Processes at Laboratory and Pilot Plant Levels

The NBS Fermentor Drive Assemblies offer a convenient and efficient means for culturing microorganisms under well-defined conditions. Temperature, agitation, pH[1], air volume and pressure can be selected and rigidly controlled while sterility is maintained.

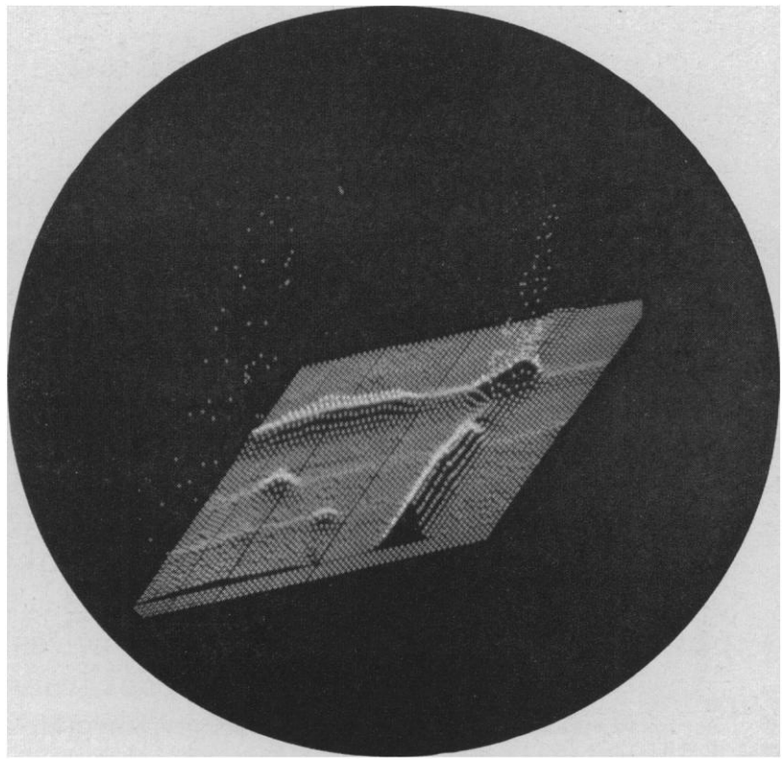
Stainless steel fermentors with Pyrex glass jars are available in 5, 7½ and 14 liter sizes. Impellers are driven through a non-freezing, stainless steel agitator housing which incorporates stainless steel ball bearings and leak-proof Teflon seals. The fermentors are easily and quickly disconnected from the drive and will sustain *repeated* autoclaving.

Water bath temperature is adjustable up to 60°C ± 0.5°C. A continuous-duty, variable speed motor enables impeller speed to be regulated between 150 and 750 rpm. Performance is quiet and dependable under continuous operation. All NBS apparatus is unconditionally warranted for one full year. **WRITE FOR CATALOG FSS/1183**

(1) Automatic pH Control and Antifoam Addition optional

NBS **New Brunswick Scientific Co., Inc.** 1130 Somerset St., New Brunswick, N.J.

Manufacturers and Distributors of Precision Laboratory Apparatus

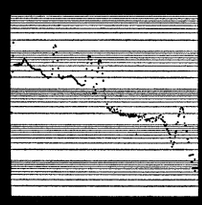


There are many ways of representing the results of two parameter measurements. Here is one, called an isometric display. This unretouched photograph shows the 511 kev line of Sodium 22.

The new 4096 channel model ND-160 analyzer from Nuclear Data provides this as well as the "contour map" display, and the standard (live) linear curve display.

This analyzer has some remarkable new features, as well as all the many fine standard ones normally expected in analyzers of this class. All features and characteristics will be announced next month. Deliveries are scheduled to start in March, 1963.

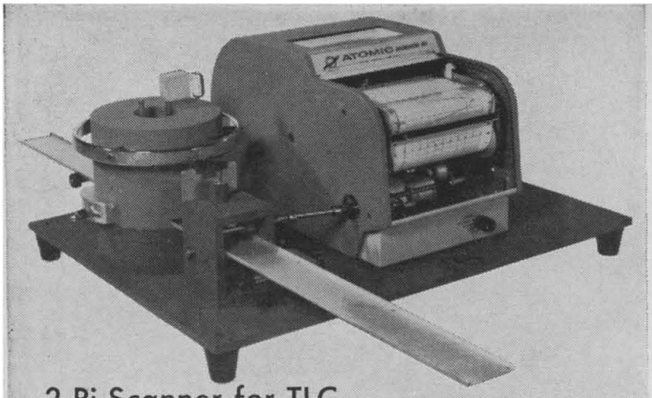
Price: Approximately $36,000.



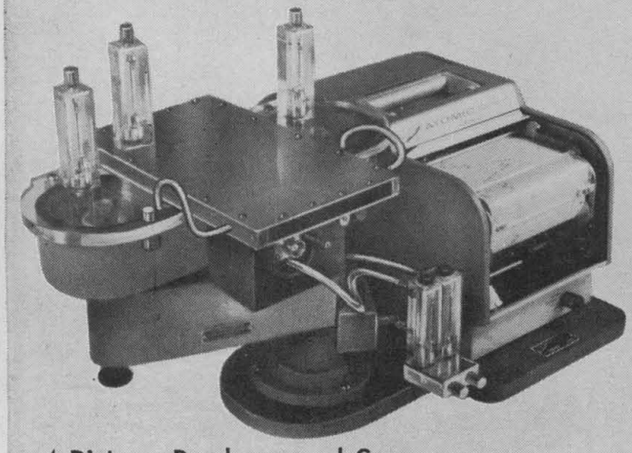
NUCLEAR
DATA
INC.

3833 West Beltline Hy.
MADISON 13, WISCONSIN

Also see page 175



2-Pi Scanner for TLC,
paper strips and thick gels



4-Pi Low-Background Scanner
for paper strips

***A statement of fact!**

Our scanners are the most efficient and versatile units available today.

Let us prove it. Just send us a test chromatogram strip. We will perform a scan, without obligation, and send you a complete report.

NOW...a complete line of Chromatogram Scanners for THIN LAYER CHROMATOGRAPHY, PAPER STRIPS, THICK GELS

The widest selection of Isotope Scanners, and the MOST EFFICIENT*, for counting Tritium, Carbon-14, Sulphur-35, Iodine-131 and others.

For Research, Medicine, Industry and Teaching

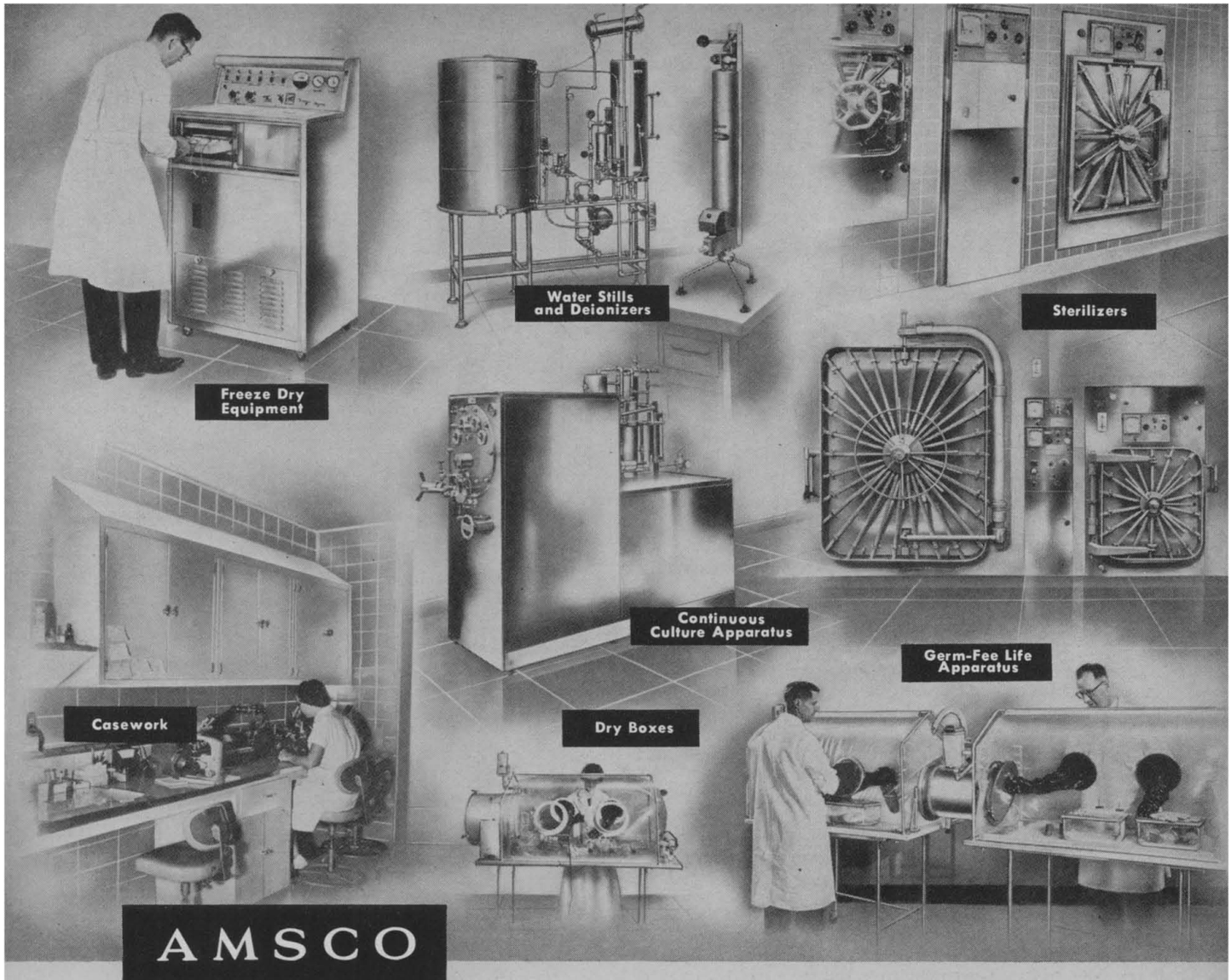
Over 25 paper-scanning systems to suit every requirement and budget: 2-pi and 4-pi models . . . window or windowless . . . optional low-background circuitry . . . automatic integration . . . for short or long paper strips, thick gels, and thin layer chromatography. Also miniature low-cost scanners for teaching purposes in the laboratory or classroom.

Write for new Scanner Catalog FS-1

Represented Nationally by Baird-Atomic Sales Offices in:

Boston • New York • Philadelphia • Cincinnati
Washington, D. C. • Raleigh, N. C. • Atlanta • Chicago
Detroit • Dallas • Los Angeles • San Francisco
In Canada: Ottawa, Ontario

ATOMIC
accessories inc.
SUBSIDIARY OF BAIRD-ATOMIC, INC.
811 W. Merrick Road, Valley Stream, New York



AMSCO

Microbiological Equipment

An ever increasing number of universities, pharmaceutical and industrial plants depend upon Amsco for quality microbiological research and process equipment . . . and for sound reason.

Amsco is geared to research, design and manufacture virtually *any* technical equipment and systems ranging from sterilizers to water stills . . . to flexible film expansion chambers for sterilization of interplanetary craft components . . . to a full line of freeze drying apparatus.

For example, on special contract Amsco recently designed and produced what is believed to be the world's largest bulk sterilizing system . . . a 30′ long x 7′ wide x 9′ high giant, utilizing pure ethylene oxide at 100% concentration as the sterilant.

Let us share *your* confidential equipment and process problems. We welcome the challenge, for the resolution of microbiological problems has become our way of life. Of course, Amsco's varied line of standard equipment, as illustrated, is a ready source for precision-made apparatus.

Please write for literature of interest to you. If you have special needs, a letter to our Scientific and Industrial Department may lead to their economical resolution.

STERILIZERS
Pressure Steam, Ethylene Oxide and Combination Gas-Steam Systems. Chambers 16″ x 16″ x 24″ to 80″ x 108″ x 360″ and larger. **SC-318.**

FREEZE DRY EQUIPMENT
Models for laboratory, pilot plant and production. Amsco Freeze Dryers feature precision control throughout the cycle. **IC-611.**

WATER STILLS and Deionizers
Still capacities from 1 to 150 gal./hr. Steam or Electric heat. Automatic or Manual Controls. **IC-601.**
Deionizers . . . From 2 to 300 gal./hr. **MC-595.**

CONTINUOUS CULTURE APPARATUS
"Biogen" Continuous Culture Apparatus produces microbial cells and/or their byproducts on a continuous or batch basis with precise control of growth conditions. **IC-605.**

DRY BOXES
Flexible film chamber type. Economical, efficient and easy to use. For laboratory and production use. **IC-607.**

GERM-FREE LIFE APPARATUS
Flexible Film Isolators for sterile delivery, rearing and transfer of germ-free animals. **IC-600.**

CASEWORK
Complete casework needs. Planning, installing and maintenance. Base, wall, storage cabinets. Counters, work tables, carts. **MC-503.**

Scientific and Industrial Department

AMERICAN STERILIZER
ERIE • PENNSYLVANIA

World's largest designer and manufacturer of Sterilizers, Surgical Tables, Lights and related technical equipment for Hospitals, Industry and Research.

COLEMAN

Coleman pH Instrumentation

Three pH meters and complete selection of electrodes meet full range of laboratory pH measurement requirements

Low-cost Metrion pH Meter is a line-operated instrument featuring a basic simplicity of design and operation which make it ideal for general-purpose laboratory use. With measurement accuracy to 0.05 pH, the Metr*ion* provides a level of performance far out of proportion to its moderate cost.

Features:

- Stabilized against line voltage fluctuations over 95-125 volt range.
- Easy-to-read duplex scales cover 0-14 pH range.
- Calibration control provides compensation for temperature effect.
- Simplified operation—"push-to-read" pH control.

Cost—only $139.00.

Increased versatility, Metrion II pH Meter offers the same simplicity of design and operation as the basic Metr*ion*. It also features two additional circuits for increasing versatility of the instrument:

...a true temperature-compensating circuit with a control knob conveniently located on instrument's front panel.

...an output jack for use with an automatic titrator such as the Coleman Titr*ion*.

Addition of these two circuits makes the Metr*ion* II valuable for an increased variety of specialized laboratory applications with only a small price increase.

Cost—$160.00.

Fully-versatile Companion pH Meter is a zero-restoring instrument ideal for a broad range of laboratory applications. It provides pH measurement over the 0-14 pH range with a routine accuracy of 0.05 pH and reproducibility within 0.02 pH. The instrument also may be used for millivolt measurements over a 1400 mv span.

Features:

- Zero-restoring circuit for drift-free operation.
- May be used with recorder, automatic titrator, and automatic temperature compensator accessory.
- Simplified control system for easy operation.
- Manual Temperature Compensator control permits accurate measurement over 0-100° C. range.

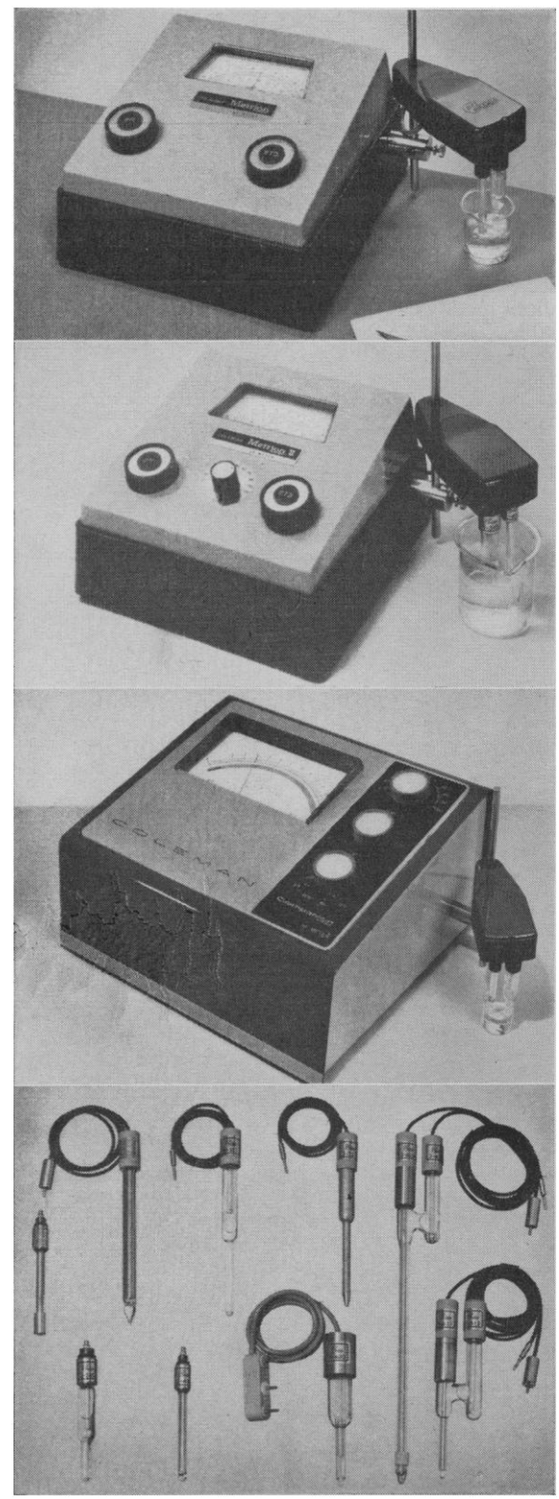
Cost—$300.00

Complete selection of electrodes—Coleman electrodes cover virtually every practical application of laboratory pH measurement. They are usable with any Coleman pH meter or other instrument of modern manufacture.

- Glass electrodes, shielded against stray electrical fields, permit precise measurement over widely-varying conditions of temperature, viscosity, alkalinity.
- Reference electrodes are available in standard calomel or non-mercurous types.
- Metallic electrodes for electometric titrations.
- Special-purpose electrodes for unusual applications.

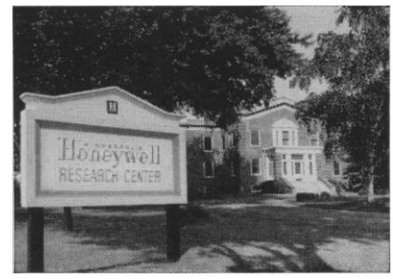
Coleman electrodes are priced about one-third less than the closest competitive designs.

Write for full details



COLEMAN INSTRUMENTS, INC., MAYWOOD, ILLINOIS

Basic Research at Honeywell
Research Center
Hopkins, Minnesota



The Study of Surface States on Clean Semiconductor Surfaces

The electrical properties of a semiconductor are drastically modified by effects that occur on the surface. A new cleavage method enables scientists to measure true properties on perfectly clean surfaces.

The effects of the surface on the electrical characteristics of a semiconductor are well known. While the proper semiconductor materials can be prepared to produce the desired characteristics in the bulk material the surface effects can drastically alter these desired characteristics. Desired surface effects are now obtained through empirical means, although at present it is not understood why these empirical approaches work.

The problem then becomes to theoretically define what surface characteristics are desired and in turn manufacture the surface so as to be simple and reproducible.

There are states at the surface of a semiconductor that can both attract electrons from the bulk material and give up electrons to the material. One type of state, associated with the material itself, derives from the fact that absolutely clean surfaces have surface states available. Some scientists associate this with dangling valence bonds while others, solving the equations of the crystal, assume extra states are available.

A second type of state occurs because adsorbed atoms on the surface can pick up or donate electrons to the material.

The change in charge density at the surface resulting from the surface states causes three important electrical effects:

Conductance changes because charges coming from the material are trapped at the surface leaving fewer carriers or electrons in the material.

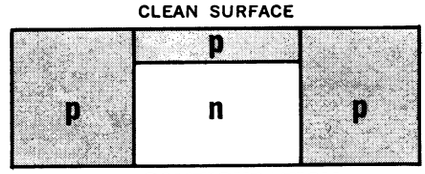
Work function, the measure of the energy required for an electron to move out of the material into free space, changes because the charges placed on the surface set up an electrical field at the surface.

The lifetime of the material, the time for an excited electron to return to its normal bound position in a crystal lattice, changes due to the same electrical field and because it extends into the bulk material.

In the past a large amount of work has been done on surface states where the surfaces were chemically etched. This procedure produced most of the fundamental results presently used but has the inherent limitation of making it impossible to determine the nature of the types of atomic species on the surface.

More recently scientists have worked with sputtering techniques where the surface is cleaned by a bombardment of atoms under an inert gas. The atoms remove the impurities but also disturb some layers of the material under study thereby changing the conductivity of the semiconductor. Also there is a question of whether the surface is actually atomically clean or whether there is a small number of foreign atoms remaining.

Honeywell scientists were the first to prepare a fresh surface by cleaving a piece of semiconductor material under an ultra-high vacuum in such a way that electrical measurements can be made.



pnp CONFIGURATION
FOR SURFACE STUDY

In germanium the surface states are such that the material nearest the clean surface is p type or a type of material that conducts by holes or vacancies. In a pnp configuration (see diagram) there is a conducting path between the p type regions. (The n type conducts by electrons.) The p type layer is entirely controlled by surface states. Therefore any changes in the characteristics of the layer can be associated with changes in surface states.

By applying a voltage across the two p regions the conductivity through the layer, or channel can be measured easily. This conductivity, or hole density of the channel, can be plotted as a function of the voltage between the n region and the channel. By analysis the energy and density of the surface states can be determined. With the density of the surface states for the particular material determined oxygen is introduced and the number of surface states resulting from both inherent and adsorptive surface states can be measured.

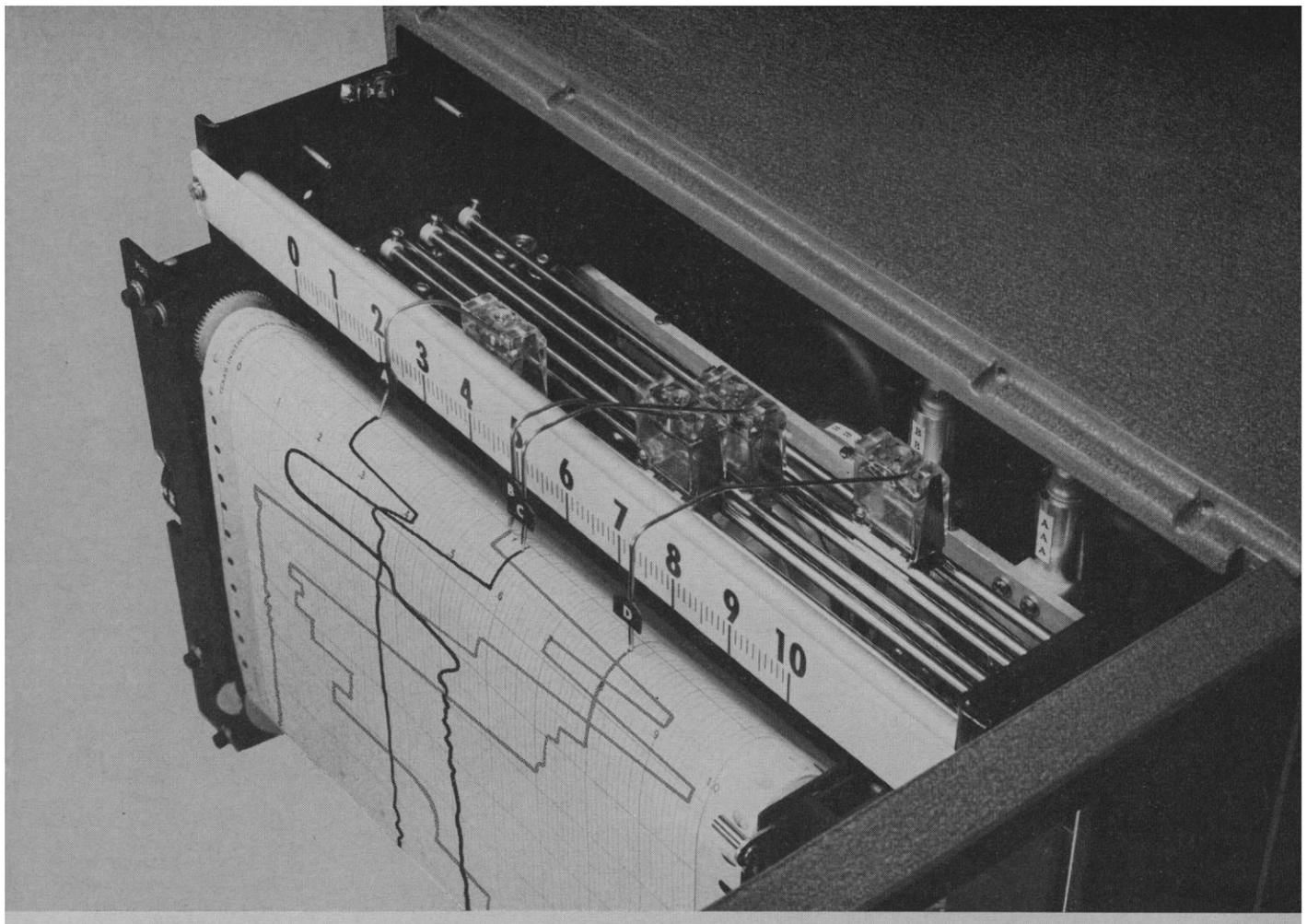
With the ability to determine the surface states, both inherent and adsorptive, it is possible to more clearly understand what occurs at the surface. This is an important step towards the ability to define what surface states are produced by different gases and different semiconductor materials. With further analysis it is possible to determine what arrays or types of surface states are desired for good transistor characteristics.

Further research should eventually lead to methods for controlling surface states and laying down surface states at will in the same way that impurities are introduced into basic semiconductor materials to produce desired characteristics.

For the chemist, information on the nature of surface states and their control will be an important step in defining the reactivity of adsorbed species on the surface. This will in turn be significant in understanding catalytic phenomena.

If you are engaged in scientific work involving surface states and wish to know more about Honeywell's research in this area, you are invited to correspond with Dr. S. Roy Morrison, Honeywell Research Center, Hopkins, Minnesota.

If you are interested in a career at Honeywell's Research Center and hold an advanced degree you are invited to write Dr. John Dempsey, Director of Research at this same address.



only servo/riter* recorders offer uninterrupted multi-channel recording with wide chart resolution

OVERLAPPING PENS

For the first time in a potentiometric instrument, **continuous** recording of up to six variables can be made on a single chart. Up to four channels of data can be recorded with the high resolution attained only on a 9¾" grid — all four overlapping pens record across the full chart width.

TWO TO SIX CHANNELS

Five and six channel ***servo/riter*** recorders utilize overlapping pens on dual side-by-side 4½" grids. Two and three channel recorders are offered in both narrow and wide chart configurations with all pens writing on only one sheet of chart paper.

REMOTE AMPLIFIERS

Amplifiers are separate from the recorder and may be mounted as far as 15 feet from the recorder chassis. An optional assembly places amplifiers in a standard rack-mounting case to be located adjacent to the recorder.

CHOICE OF INPUTS

There is an industry-proved ***servo/riter*** recorder for every application. Single and dual channel, narrow and wide grid, portable, flush-mounting and multi-channel instruments — all offered in the widest selection of high impedance or high rejection input ranges with mercury or Zener regulated reference and other options.

WRITE FOR COMPLETE INFORMATION.

*A Trademark of Texas Instruments

INDUSTRIAL PRODUCTS GROUP
STRIP CHART RECORDERS
TEST EQUIPMENT
DATA SYSTEMS
TRANSDUCERS

TEXAS INSTRUMENTS
INCORPORATED
3609 BUFFALO SPEEDWAY
P. O. BOX 66027 HOUSTON 6, TEXAS

monitoring UV

...across the spectrum with just a turn of a **DIAL**

Now with just a turn of a dial you can continuously monitor column effluent for compounds absorbing at any wave length in the ultraviolet spectrum. Vanguard's all-new Model 1056 Automatic UV Analyzer performs with greater sensitivity and versatility than ever thought possible. Dual-beam operation utilizing sample and reference cuvettes provides continuous base line compensation for gradient elutions and for other applications where the optical density of the eluent may change. Operates with minimum supervision and compatible with all Fraction Collectors. Automatic chart recorder marking system speeds identification by quickly and accurately locating test tubes in which absorbing materials are located.

To learn how you can save time while assuring positive identifications—even in the presence of highly absorbing solvents—write direct for complete details on the new Vanguard Model 1056 Automatic UV Analyzer.

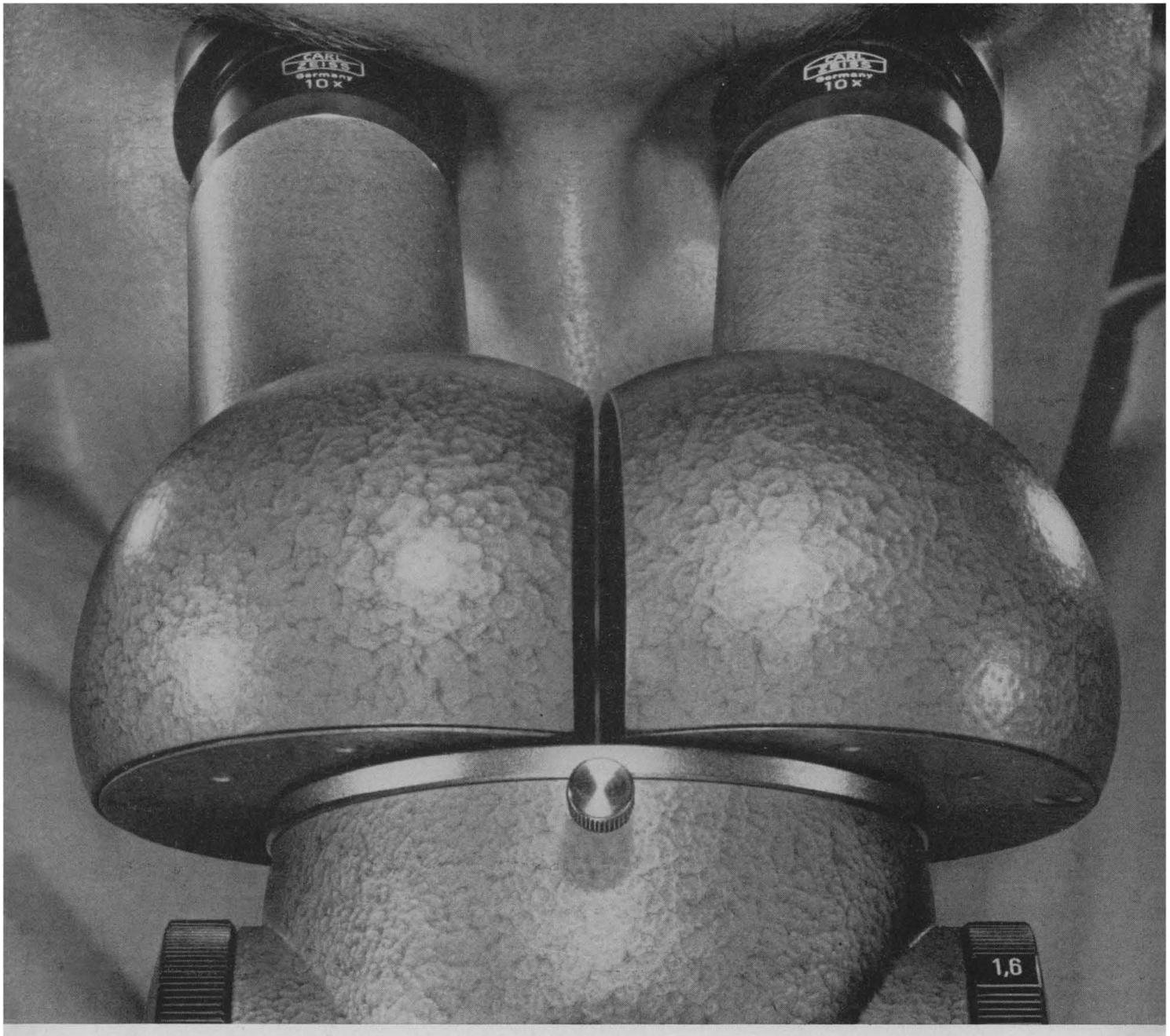
- Analyzes across the spectrum—from 200 to 400 millimicrons
- Particularly well-suited for gradient elution techniques—even when highly absorbing solvents are utilized
- Monochromator-coupled hydrogen light source permits selective dialing across UV spectrum
- Automatic chart recorder marking system locates absorbing materials by test tube
- Compatible with all Fraction Collectors—regardless of make or model
- Fully transistorized for long, precision service

VANGUARD
INSTRUMENT COMPANY

DESIGNERS AND MANUFACTURERS OF PRECISION INSTRUMENTATION FOR RESEARCH

P.O. Box 244 • LaGrange, Illinois • Fleetwood 4-5656

Regional Offices: New York, New York, 520 Fifth Avenue, TN 7-1998; San Francisco, California, 115 New Montgomery Street, EXbrook 2-0511

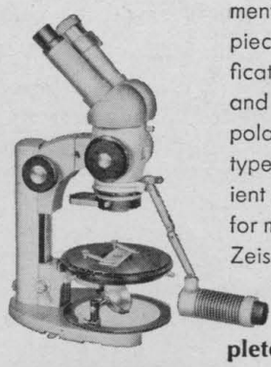


Three Dimensional View...Long Working Distance

The Carl Zeiss Stereo Microscope II is an indispensable instrument for routine and research studies in biological, zoological, medical, geological and industrial laboratories.

Ease of operation is unsurpassed. A single, five-position magnification changer increases the image from 6x to 40x with a pair of 10x eyepieces—without altering the 3⅛" working distance or focus. Eyepiece tubes are inclined for comfortable viewing, adjustable for interpupillary distance, and can be rotated 180°.

Flexibility is unequalled. Carl Zeiss provides an unusual variety of accessories for the Stereo Microscope. They can be used in virtually unlimited combinations to adapt the instrument to your specific requirements. Interchangeable eyepieces and an attachment objective give a range of magnifications from 2.5x to 200x. Stages are available for routine and specialized studies. Accessories can be supplied for polarized light microscopy. You can choose from several types of table stands, or a movable floor stand for convenient placement, whatever the subject. Adaptors are available for making stereo or single frame 35mm. photographs with the Zeiss Ikon Contarex Special.

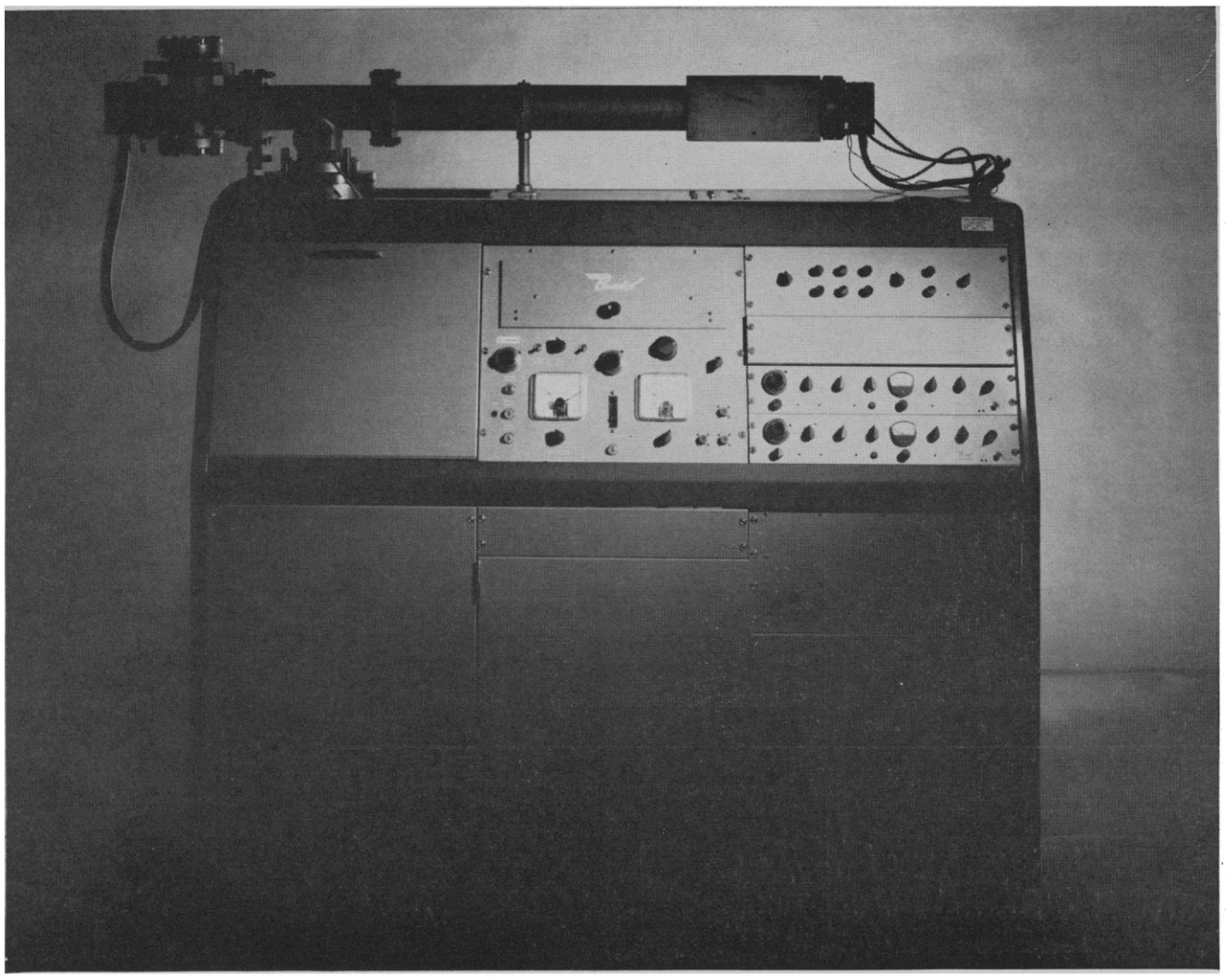


Write for a copy of our detailed booklet which describes this unique Stereo Microscope system. **Complete service facilities available.**

CARL ZEISS
WEST GERMANY

The Symbol of World Famous Optics

Carl Zeiss, Inc., 444 Fifth Ave., New York 18, N.Y.



This T.O.F.* analyzes anything

(almost)

There is something the Bendix® Time-of-Flight Mass Spectrometer won't analyze. Diamonds! But hand it any other material and you'll get your quantitative-qualitative analysis fast . . . and accurately. Its versatility is unsurpassed for analytical purposes, research projects or industrial process control.

Depending on project needs and equipment, you can get up to 100,000 spectra per second, unit resolution up to mass 350 and a sensitivity of 1 to 5 ppm. With the analog output system you can record both positive and negative ion spectra and can simultaneously record up to six preselected masses.

The unit is compact and easy to move. Maintenance involves little more than knocking the dust off once a week. And the list of things it can do in the way of analyzing won't even give the dust a chance to collect. Models range from $17,000 to $100,000. What would you like to analyze? Dept. C-1, 3130 Wasson Road, Cincinnati 8, Ohio.

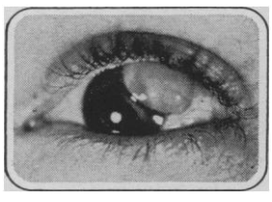
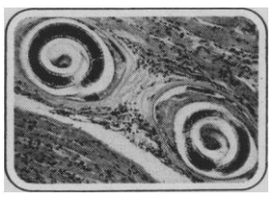
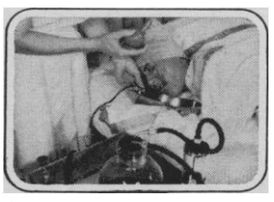
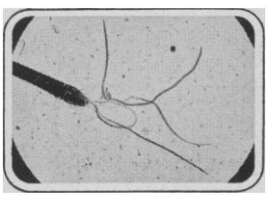
Time-of-Flight Mass Spectrometer

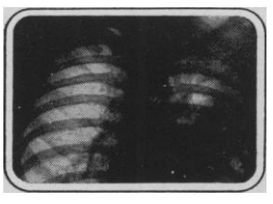
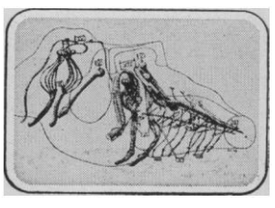
Cincinnati Division

THE Bendix CORPORATION

when seeing is essential to understanding, use MEDICHROMES®

MEDICHROMES are full-color Kodachrome slides . . . 10,000 of them on more than 70 subjects in the biological sciences and medicine. * Each series is authored by leading world authorities on the subject. * MEDICHROMES visualize subject matters which must be seen to be understood. * They facilitate thorough and rapid coverage of topics. * Both microscopic and gross subjects can be demonstrated clearly and simultaneously to an entire class. * Easy to use for lecture work as well as individual study, all Medichrome slides are in full color, 2 x 2″ (35 mm.) and are available bound between glass and aluminum or in cardboard Readymounts.

Available as complete series or individual slides to supplement your present slide library.
For complete information on any series fill out the coupon below and mail it to us.

1. Anatomy
2. Bacteriology
3. Biology
4. Botany
5. Cytology
6. Dermatology
7. Embryology
8. Hematology
9. Histology
10. Neuroanatomy
11. Neuropathology
12. Nursing Procedures
13. Obstetrics and Gynecology
14. Oral and Facial Pathology and Anatomy
15. Pathology
16. Pediatrics
17. Virology

Clay-Adams
New York 10, N. Y.

CLAY-ADAMS
141 E. 25th St., New York 10, N. Y.

Please send me complete descriptive information on the Medichrome series I have circled. (See listing at left)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

I am also interested in:

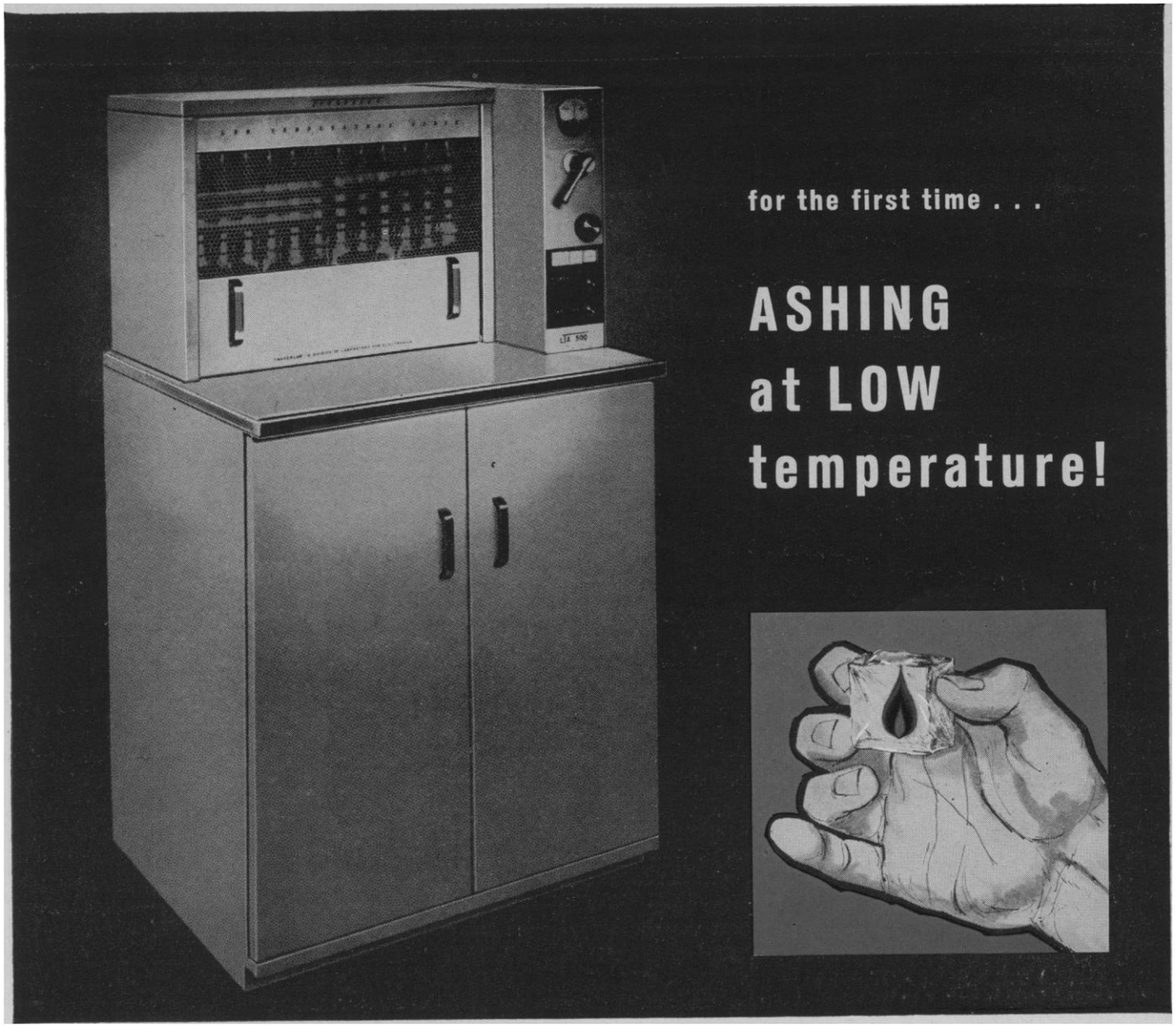
_____
(other fields of interest)

Name_____

Institution_____

Street_____

City_____ Zone____ State_____



the new electronic Tracerlab LTA-500

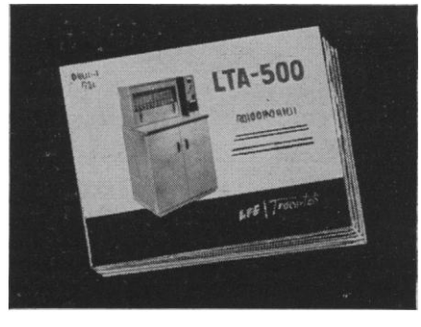
. . . presents the modern analyst with the first revolutionary change in ashing technique. This new and unique instrument covers all studies in which elemental analysis of organic samples is required.

Low temperature ashing is a radical departure from traditional techniques of sample decomposition. Most techniques require energy, usually in the form of heat, to be applied directly to the specimen, thus leading to the destruction of inorganic constituents. In the LTA-500, a high purity stream of ionized and atomic oxygen, produced by a high frequency electromagnetic field, is the **only** oxidizing agent.

This method permits controlled ashing of samples in which quantitative retention of inorganic elements or retention of mineral structure is critical. Sample temperatures during the ashing process do not exceed 150° C. The high reactivity of the electronically excited oxygen insures quantitative conversion of carbon and hydrogen into their respective oxides. Proteins, carbohydrates, vegetable matter, graphite, and small whole animals can be ashed, with no carbonaceous residue.

The new LTA-500*

• Creates new standards of operating convenience and time economy • Volatization and diffusion losses eliminated or substantially decreased • Eliminates tedious wet ashing • No chemical additives required • Eliminates reagent contamination • Ashes up to 12 samples simultaneously (also available as a one large sample model) • Unit adaptable for downstream cold trapping



For complete information on this versatile instrument, including full lab test reports, write to:

*Patent pending

LFE

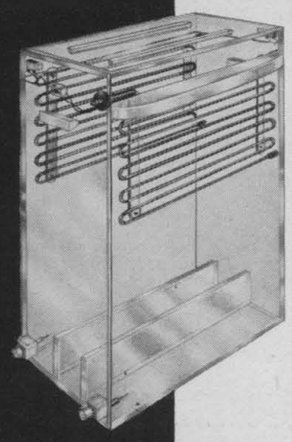
Tracerlab

A Division of Laboratory for Electronics, Inc.
2030 Wright Avenue, Richmond 3, California

SAVANT

(formerly SERVONUCLEAR CORP.)

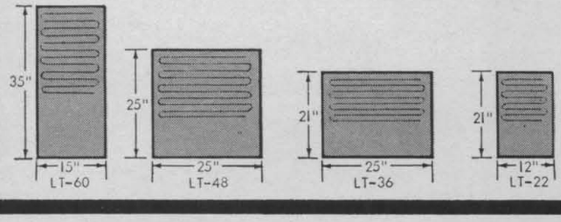
1st in High Voltage Paper ELECTROPHORESIS *Systems*



The ONLY system that allows VISUAL INSPECTION during operation

for

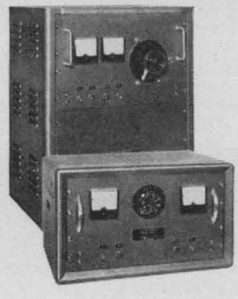
+ *Identifying and characterising Protein Material*
+ *Amino Acid Analysis*
+ *Peptide (Fingerprinting)*
+ *Nucleotides*
+ *Nucleic Acids*



Five complete Electrophoresis systems for every type of laboratory

Savant's precision engineered tanks are constructed of Lucite or Fibreglass as the main structural material. They are inert to most chemicals used in Electrophoresis application and the Lucite tank has the distinct advantage of being transparent. The investigator sees at all times what is taking place.

Tank racks will accept paper from 8" to 60" in length, up to 20" in width. The paper is cooled by a high flash point liquid, aliphatic-hydrocarbon, Savant EC-123. It is now possible to achieve the maximum resolution through the application of higher voltages, up to 10,000 Volts. Today, laboratories around the world are using Savant's Lucite and Fibreglass tanks with confidence.

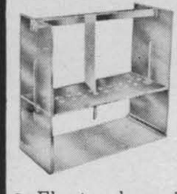


6 HIGH VOLTAGE POWER SUPPLIES

10 KV • 5 KV • 2 KV • 400V

- **All solid state**
- **Instant starting**
- **Low voltage interlock**
- **Overload circuit with front panel indication**
- **Zero start**

Only Savant Power Supplies have the advanced engineering and essential features for high voltage and high current applications.

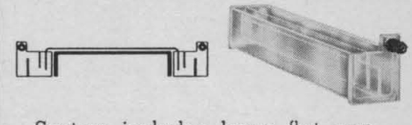


Lucite ELUTION RACK

Model ER-20

- 100% sample recovery
- Elute up to 20 samples at one time
- Electrophoresis or Chromatography
- Paper length may vary from 2" to 10"

FLAT PLATE ELECTROPHORESIS SYSTEM • Model FP-24



System includes large flat anodized aluminum plate with cooling coils mounted below. Two Lucite electrode vessels with spaced baffles and platinum electrodes. Entire system enclosed in a safety interlocked box.

Savant products are available from stock or depending on your requirements, will be designed to your exact specifications.

ELECTROPHORESIS COOLANT EC-123 for High Voltage Paper Electrophoresis Tanks

High flash point, Odorless, Colorless. It is totally iso-parafinic; synthesized from aliphatic gases and controlled to yield a coolant of highest quality. Packaged in 5 gal. cans.

WHATMANN 3MM PAPER

Whatmann 3MM paper for Electrophoresis and Chromatography applications 10¾" or 20" wide, to fit Savant tanks.

Investigate today, write for complete illustrated literature.

SAVANT INSTRUMENTS, INC.

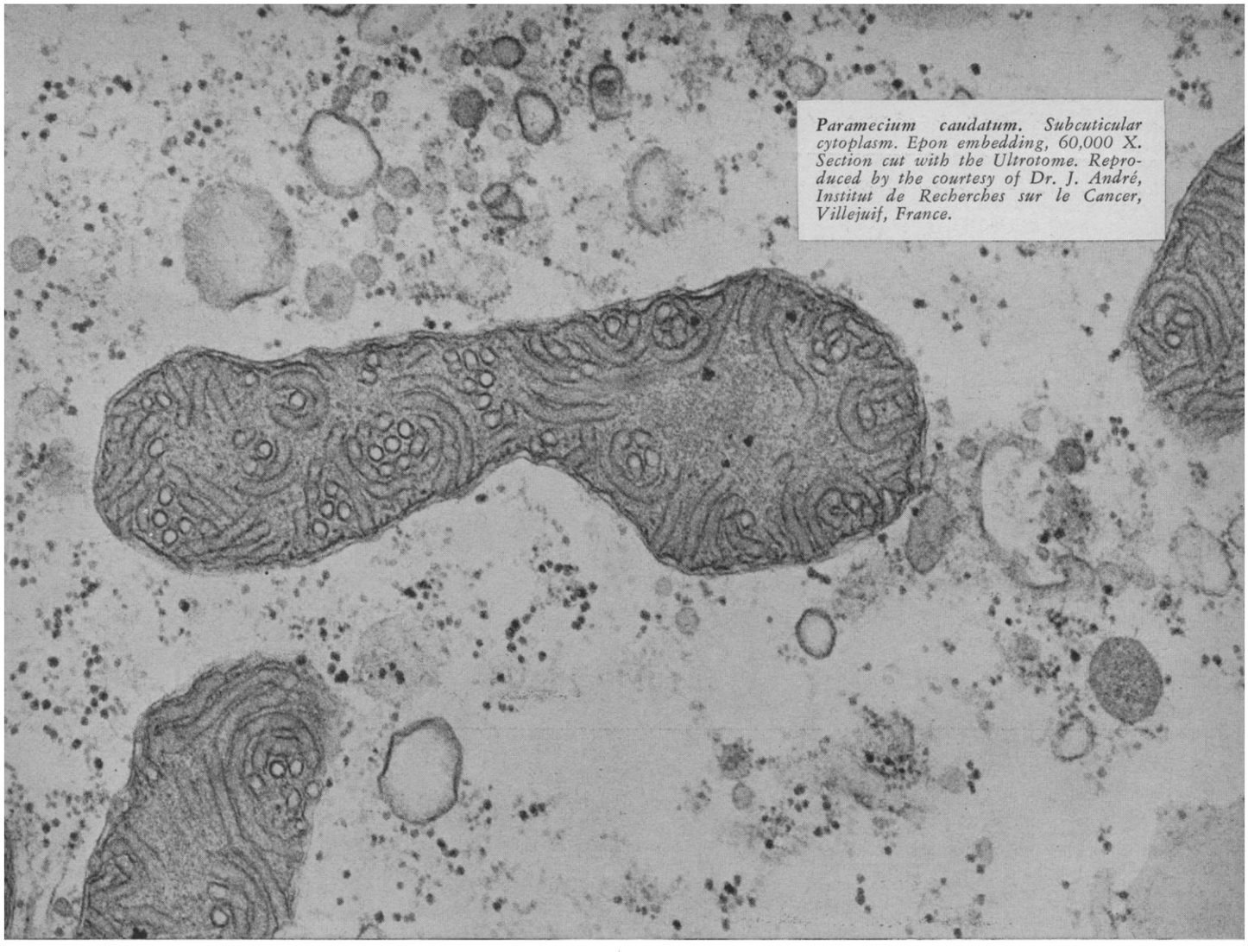
221 Park Avenue • Hicksville, New York

IMAGINE IF...

SIR RONALD ROSS (1857-1932), discoverer of the material parasite in mosquitos with the microscope shown...imagine if SIR RONALD ROSS had been equipped with this new ELGEET-OLYMPUS Medical and Research Microscope, the HM-4S. This new modular-styled microscope is available in numerous combinations of oculars, objectives and accessories, fully described in the Booklet HM561, available on request. The Model HM-4S with quadruple nosepiece including 4X, 10X, 40X and 100X (oil immersion) objectives and the accessory mechanical stage (illustrated)...$218.45; without accessory mechanical stage . . . $193.45 with case. **ELGEET**

EL-69

ELGEET OPTICAL CO. SCIENTIFIC INSTRUMENT DIV., 838 Smith St., Rochester 6, N.Y.



Paramecium caudatum. Subcuticular cytoplasm. Epon embedding, 60,000 X. Section cut with the Ultrotome. Reproduced by the courtesy of Dr. J. André, Institut de Recherches sur le Cancer, Villejuif, France.

BIOLOGICAL SECTIONS OF

QUALITY IN QUANTITY

FROM THE ULTROTOME®

Fine results like the reproduction above are already published by many of the 500 Ultrotome users throughout the world. Each of these micrographs is an eloquent demonstration to the specialist.

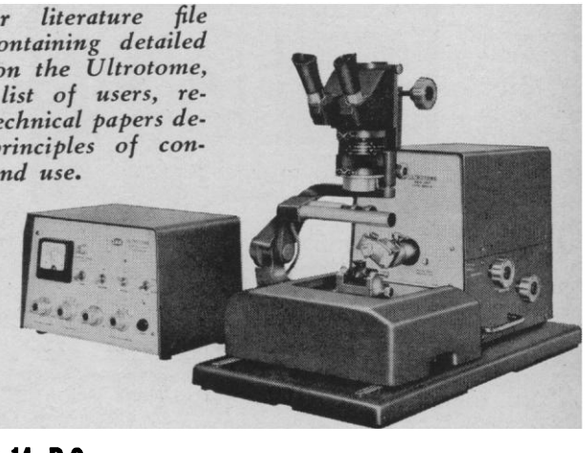
High Quality sections of uniform thickness are produced without chatter from specimens in Epon, Vestopal, Araldite, methacrylate and paraffin. Even hard materials like bone and certain metals are cut excellently.

Unlimited Quantity of ultrathin (100-1000 Å), thin (0.1 μ), or thick (1-10 μ) sections can be cut in long series or short, just as you will at a mere turn of a knob.

A wide range of accessories and supplies has been developed for the Ultrotome to promote efficient microtomy. These include specimen orientation head with vernier scale, plug-in specimen holders in 6 sizes, 26 types of specimen grids, grid storage box, and diamond knives.

Note: Non-profit institutions may now purchase the Ultrotome duty-free. Inquire for details.

Write for literature file 4800S1, containing detailed brochure on the Ultrotome, reference list of users, reprints of technical papers describing principles of construction and use.



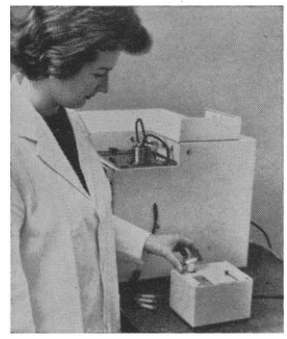
LKB®

LKB Instruments Inc., 4840 Rugby Ave., Washington 14, D.C.

International Headquarters: LKB-Produkter AB, P.O.B. 12220, Stockholm 12, Sweden

accurate and reproducible blood gas analyses

1



2

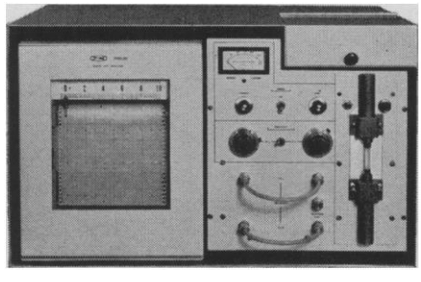
3

For a complete blood gas analysis with the Model 450, this is all that the operator has to do:

1 With an empty vial connected to the sampling valve, the operator loads the valve with an excess of blood and positions the valve handles to obtain a precise sample of blood and releasing agents . . .

2 transfers the vial to the shaker for the desired interval required for release of the blood gases . . .

3 and then moves the vial to the gas stripping unit and pushes the programming button for the analysis of the released gases. Four minutes later, the operator reads the blood gas values directly on the chart record. No integration is required.



Now the F & M Model 450 Blood Gas Analyser brings blood gas analysis down to the practical level because:

- **The operator does not require special skills and can be trained in less than an hour.**

Each step in the analytical procedure is automated in the Model 450: the operator does not even have to measure the blood or reagent volume. This greatly increases the reliability of the analytical results.

- **The Model 450 provides rapid and precise blood gas values.**

Tests of the Model 450 in hospitals and laboratories across the country have proved the instrument's ability to produce clinically valid results that compare favorably with the Van Slyke method and in one-fifth the time (details on request).

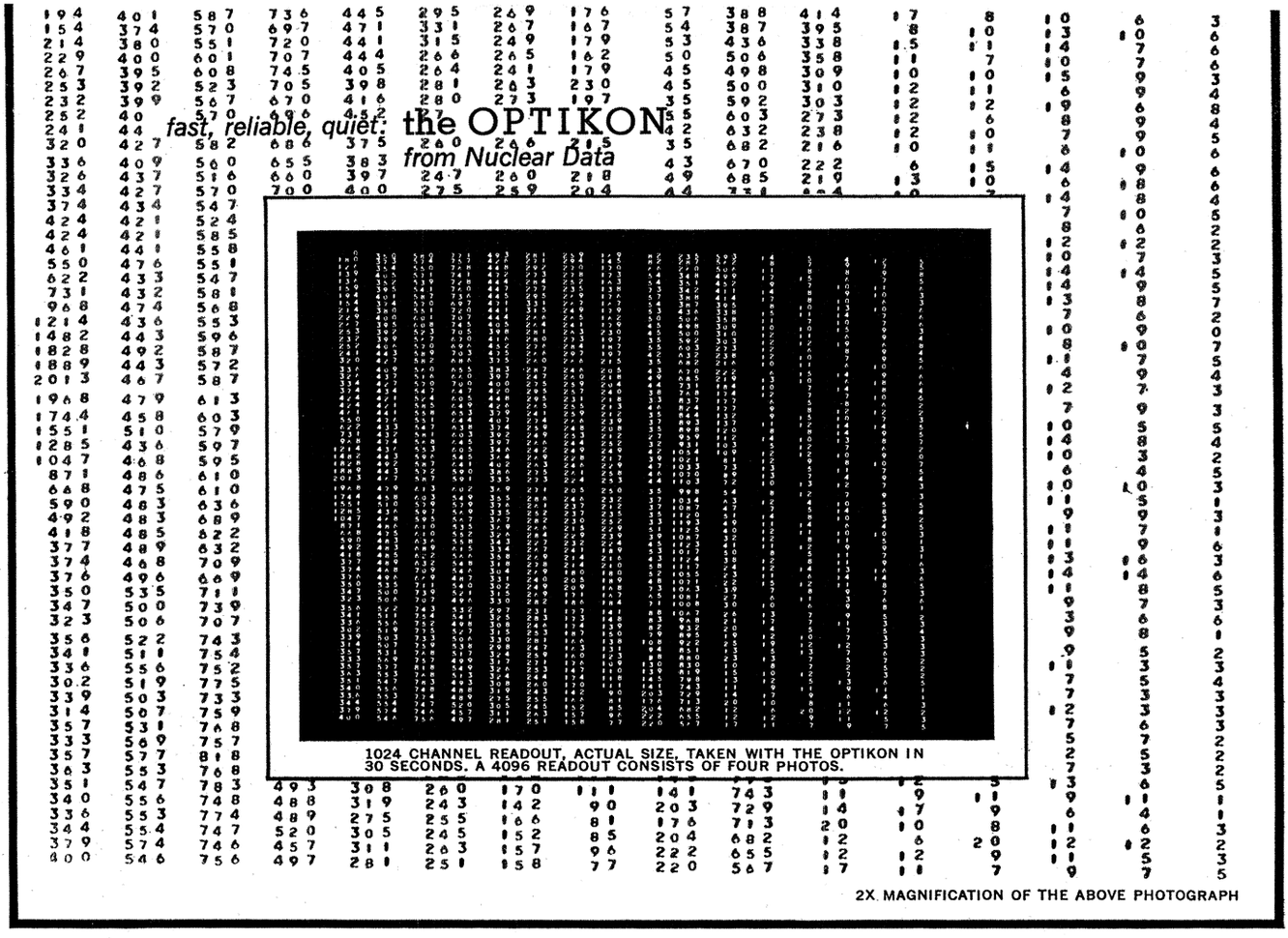
We'll be happy to send you a copy of a new bulletin that completely describes the Model 450. Write or phone F & M Scientific Corporation, Starr Road and Route 41, Avondale, Pennsylvania, 215-COlony 8-2281.

F&M

F & M SCIENTIFIC CORPORATION

AVONDALE / PENNSYLVANIA

SALES OFFICES: Atlanta • Boston • Chicago • Dallas • Cleveland • Houston • Los Angeles • New York • Pittsburgh • St. Louis • Toronto • Washington



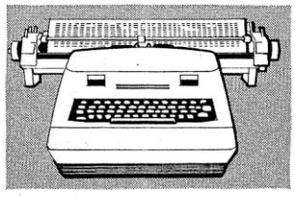
1024 CHANNEL READOUT, ACTUAL SIZE, TAKEN WITH THE OPTIKON IN 30 SECONDS. A 4096 READOUT CONSISTS OF FOUR PHOTOS.

2X MAGNIFICATION OF THE ABOVE PHOTOGRAPH

WHAT IS THE READOUT TIME FOR A 4096 CHANNEL ANALYZER?

Printed readouts from multichannel analyzers have always been too slow. For the smaller analyzers, those with 256, 400 or 512 channels, experimental time lost during readout is serious enough; but for the new line of analyzers, those with 1024, 4096 or more channels, the problem is even worse.

Take, for example, the readout from a 4096 channel analyzer:

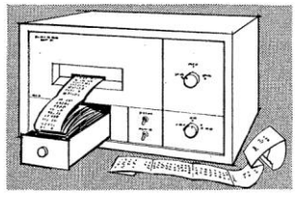


TYPEWRITER:

1 HOUR, 10 MINUTES

Using a standard computer readout typewriter (about 1 channel per second), approximately 1 hour and 10 minutes are required to read out all 4096 channels.

This disadvantage is somewhat offset by the convenient row and column format for the typed data. However, this slow speed makes the method almost prohibitive for analyzers of 4096 or more channels.

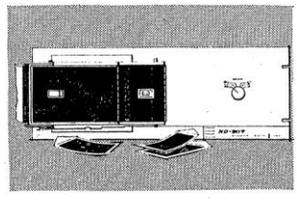


PARALLEL PRINTER:

14 MINUTES

Using a parallel printer (about 5 channels per second), approximately 14 minutes are required to read out all 4096 channels.

This advantage in speed is seriously offset by lack of format for the printed data. The readout is presented on a continuous paper strip (57 feet long for a 4096 channel readout), which is inconvenient for examination and storage.



ND-307* OPTIKON

3 MINUTES

To overcome the disadvantages of existing methods, Nuclear Data has developed a new type of fast printer, using optical techniques. Readout speed is above 20 channels per second, and the readout, in row and column format, is presented on a standard 3″ x 4″ print (10 second development time).

The photograph above shows a 1024 channel readout, actual size, taken with the OPTIKON in 30 seconds. A 4096 channel readout requires four such photos. In the original photographs the numbers are clear and easily readable by the naked eye.

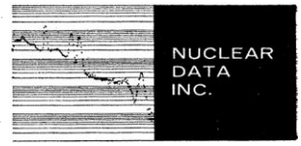
It is expected that these new printers will be extremely dependable, since they are free of the complex mechanisms and rapidly moving parts normally required by mechanical printers. Another attractive feature, directly associated with the absence of rapidly moving parts, is completely silent operation.

The complete printer is housed in a standard rack mounted cabinet, 19″ wide by 7½″ high.

The price of the OPTIKON is $3,500 F.O.B. Madison, Wisconsin. Orders are now being accepted, and deliveries are expected to begin in March, 1963.

Although this printer has been designed specifically for readout from the Nuclear Data models ND-120, ND-130A, ND-150FM and ND-160 multichannel analyzers, it can be adapted to readout from a large number of other instruments; and they will be available for such purposes after orders from Nuclear Data analyzer users have been filled.

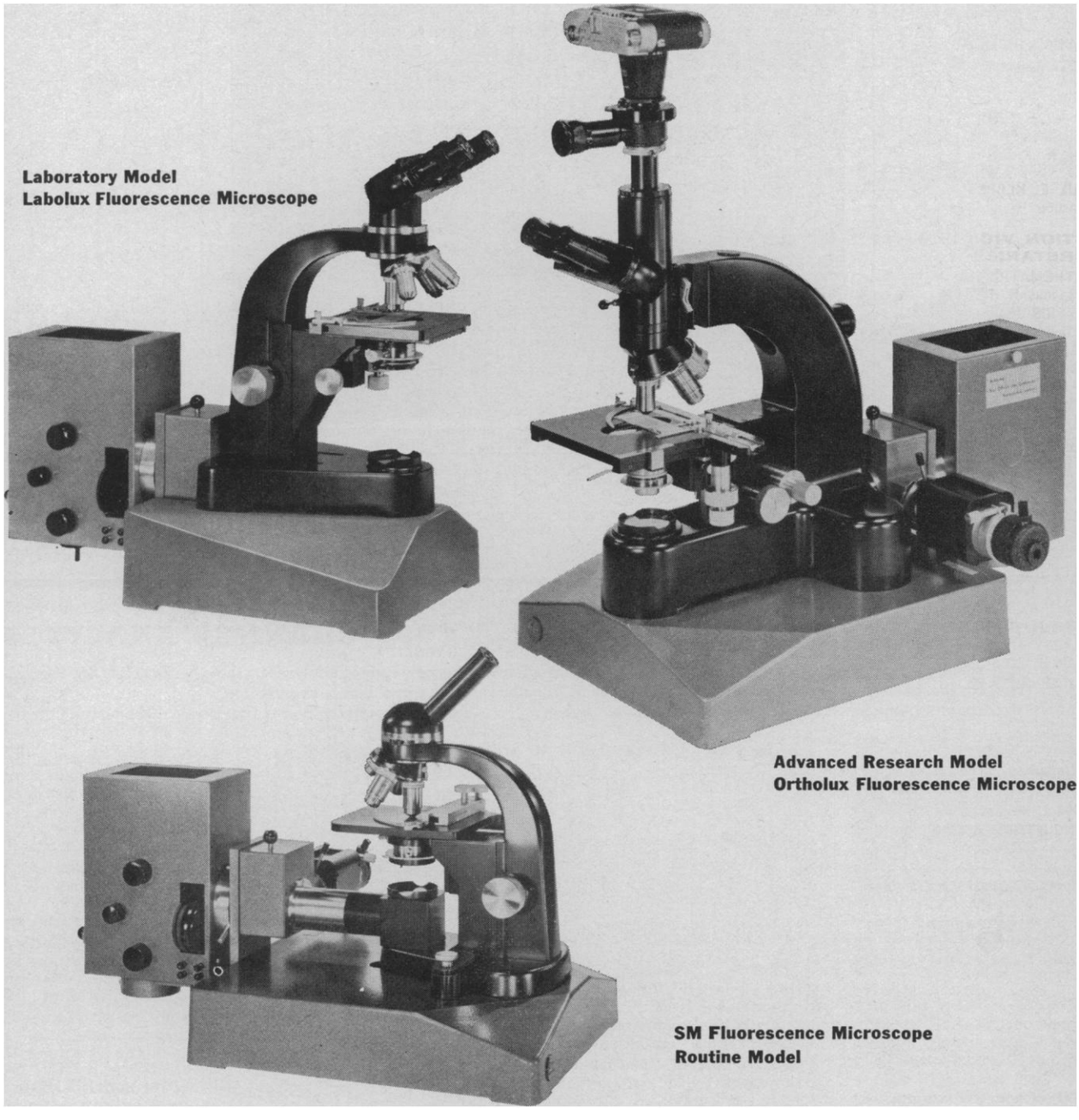
*PATENTS PENDING



3833 West Beltline Hy.
Madison 13, Wisconsin

Also see page 155

NOW! a complete range of LEITZ equipment... for every need in FLUORESCENCE MICROSCOPY



■ Leitz fluorescence equipment now makes advanced fluorescence techniques routine, dependable procedures. Highly integrated systems encompass the dramatic advantages of fluorescence methods for rapid diagnostics, practical laboratory applications and creative research, eliminating guesswork and makeshift setups. Rigid, positive alignment of microscopes and fluorescence light sources assure maximum efficiency. Yet, for each system, other filters may be added as new techniques are introduced and microscopes may be used alternately with standard light sources. Write for illustrated brochure...and for information about your special applications. 48663

Leitz

E. LEITZ, INC., 468 PARK AVENUE SOUTH, NEW YORK 16, N. Y.
Distributors of the world-famous products of Ernst Leitz G. m. b. H., Wetzlar, Germany—Ernst Leitz Canada Ltd.
LEICA AND LEICINA CAMERAS · LENSES · PROJECTORS · MICROSCOPES

18 January 1963, Volume 139, Number 3551

SCIENCE

Science Reporting

The reporting of scientific news has become a controversial matter. On 18 December, Robert C. Toth in the New York *Times* (Western edition) raised a question concerning the release of news of space research—specifically, Mariner II results.

> . . . Should the discoveries be given to the press as soon as available? Or should they, like other scientific results, be given first to the scientific community as some scientists demand?
>
> The public, whose tax funds financed the experiments, have a stake in the matter.

Toth was unhappy with policies of the American Institute of Physics. These were set forth in the 1 January 1960 issue of *Physical Review Letters*:

> Scientific discoveries are not the proper subject for newspaper scoops. . . . In the future, we may reject papers whose main contents have been published previously in the daily press.

In its 1 November 1962 issue, the *Applied Physics Letters* of the Institute adopted a similar policy:

> Work described elsewhere, for example, in press releases or in the form of abstracts of contributed papers, prior to scheduled publication in A.P.L., will not be considered eligible for publication.

Recently I have been urged by the American Institute of Physics to adhere to their position. Although generally sympathetic to their stand, I cannot completely agree. The policy seems rigid, and the attitude toward abstracts of scientific papers severe. I feel that newspapers and scientific journals are not in serious competition with each other. These media are worlds apart in audience, coverage, and precision of technical detail. It is true that the volume of news of science in daily newspapers is increasing. In Washington and New York, coverage is excellent: the writers are exceptionally competent, and sometimes adequate space is devoted to their stories. In other parts of the country science reporting ranges from fair to downright mediocre, or there is none at all. Some good, authoritative material is provided by the wire services, but local editors butcher it with a heavy hand. The material which is printed is usually gee-whiz, Buck Rogers distortions of the facts. Science writers for the wire services, wanting their copy to be used, tend to seek the more glamorous items. With distressing frequency scientist-operators are able to flim-flam the science writers with news stories which excite the imagination but have no solid technical basis. Local editors are especially susceptible to these worthless baubles, which they run in preference to less exciting items of solid merit.

The alert scientist gives only limited credence to newspaper stories. He finds them valuable as indicators of important events. To obtain full details and sufficient information to judge the validity of a claim, he knows he must consult the scientific literature.

It is tempting to try to reform operators by denying them publication in scientific journals. This mechanism would create a distortion of the true functions of journals. Other, and better, mechanisms are available. The major responsibility properly rests at the local level—with the man's scientific colleagues, with his superiors, and with properly constituted news bureaus.—P.H.A.

CONSTANT BACKGROUND

IN MODEL 402 AUTO-GAMMA® SPECTROMETERS

■ A 100 sample capacity automatic changer that assures constant sample background is one of the unique features of Packard Auto-Gamma Spectrometer Systems. In the changer, samples are located peripherally around the lead-shielded, well-type detector. Because the distance from the detector to each sample position remains constant, background remains constant even when "hot" samples are located adjacent to samples with little or no radioactivity. In operation, accurate reproducibility is assured for each sample because test tubes are allowed to bottom in the crystal well while being counted. ■ Model 402 Systems include instrumentation, sample changer, controls and printer, all in a compact console only 31½ in. wide. ■ Other Packard gamma counting systems provide the capability for automatic spectrum analysis, dual channel gamma counting, and the continuous measurement of transient gamma radioactivity. ■ For more information, call your Packard Sales Engineer or write for Bulletin 1004.

Packard

PACKARD INSTRUMENT COMPANY, INC.
BOX 428 • LA GRANGE, ILLINOIS • HUNTER 5-6330

Sales offices in principle cities in the world.

UNEXCELLED OPTICS, MECHANICAL RUGGEDNESS AND A VERSATILITY AS FLEXIBLE AS YOUR NEEDS

These things will impress you about the Nikon S:

First, *as you look at it,* its physical appearance; its rugged, substantial construction; its rigidity; and its obvious ability to stand up to constant use and handling.

Second, *as you try the controls,* the smooth responsive 'feel'; the positive action; the complete absence of vibration or chatter — not the slightest trace of 'play' or 'back-lash'.

And third, *as you look through the eyepiece,* the clear delineation of field; the brightness and definition of image; the visual ease; and the almost incredible resolution characteristic of Nikon optical quality.

The Nikon S Microscope is a basic, practical instrument whose capabilities are as varied as your changing needs. A veritable 'workhorse' for routine applications, you can rely on the same Nikon S to qualify as a 'specialist' whenever special needs arise. The Nikon S handles dark-field as well as bright-field microscopy — phase-contrast, polarizing, incident light, and transmitted light interference microscopy. And with the Nikon Microflex, the S is equipped for high quality photomicrographs using famous Nikon 35mm cameras.

Note that the various component parts of the Nikon S microscope are freely interchangeable to suit virtually any preference or need. There are plain, circular floating and rectangular mechanical stages; 45° eyepiece tubes: monocular, binocular and trinocular; fixed substage lamp and external adjustable illuminator; and a variety of measuring accessories.

The rectangular mechanical stage provides cross-wise slide movement, and is equipped with calibrated coaxial controls. One of its unique features is that it can be rotated 180° for either right-hand or left-hand operation.

The standard Abbe (n.a. 1.25) condenser, supplied with the Nikon S, is equipped with a variable aperture diaphragm which can be easily centered for normal work, or decentered for oblique illumination. This consenser is also readily interchangeable for dark-field and other special types.

Available optics include Huygenian and compensating eyepieces, and a full range of dry and oil-immersion objectives, including a 'no-cover-glass-corrected' 40x (n.a. 0.65).

Write for complete details to Dept. S-1

NIKON INCORPORATED • Instrument Division • 111 Fifth Avenue, New York 3, N. Y. • Subsidiary of Ehrenreich Photo-Optical Industries, Inc.

optical inspection instruments, scientific and industrial microscopes, surveying instruments, cameras, telescopes, binoculars and other precision optical equipment.

NIKON LABORATORY MICROSCOPE Series S


PYREX BRAND MEASURING WARE

Does measuring ware have to be delicate to be accurate?

Not when you've put more than 40 years into the making of PYREX® measuring ware that's tough as well as precise.

You *know* PYREX ware is accurate. It must be to pass the tough tolerance tests we put it through. But, even more important, you learn that you *use* this accuracy longer, simply because the ware *lasts* longer.

We start with the best-balanced borosilicate glass ever made. It's proportioned in flask walls to give strength to what could be a fragile bubble. Then we teach machines to reproduce that proportion a million times without a variable.

We've added other machines that draw tubing so accurately you can cut a uniformly perfect pipet or buret from any foot in a mile of it.

We've put in other innovations—such as ACCU-RED™ graduations, which are fused into the glass surface without an etch pattern to weaken it, and the extra bevel that strengthens our pipet and buret tips.

These are the factors which add up to the *big plus*—accuracy plus long life. They are the reasons why PYREX labware catalog LG-2 is your best source of accuracy *plus* strength . . . by the piece, the case, or the carload. Discounts run as high as 28%. Laboratory Glassware Dept., 7105 Crystal Street, Corning Glass Works, Corning, N. Y.

RUB THE TIP OF A PYREX PIPET. It's as round and smooth as a ball-point pen, to reduce snagging and chipping. We put two bevels on every tip to do that job. Accurate-bore tubing gives you uniform accuracy and strength from tip to top.

LOOK WHERE THE STOPCOCK JOINS THE BODY OF A PYREX BURET. We add glass to add strength there and in the shell of the stopcock itself. Double-beveled tips. Accurate-bore tubing. For real ease of operation, try our unique reverse-taper Teflon* plug stopcock† model.

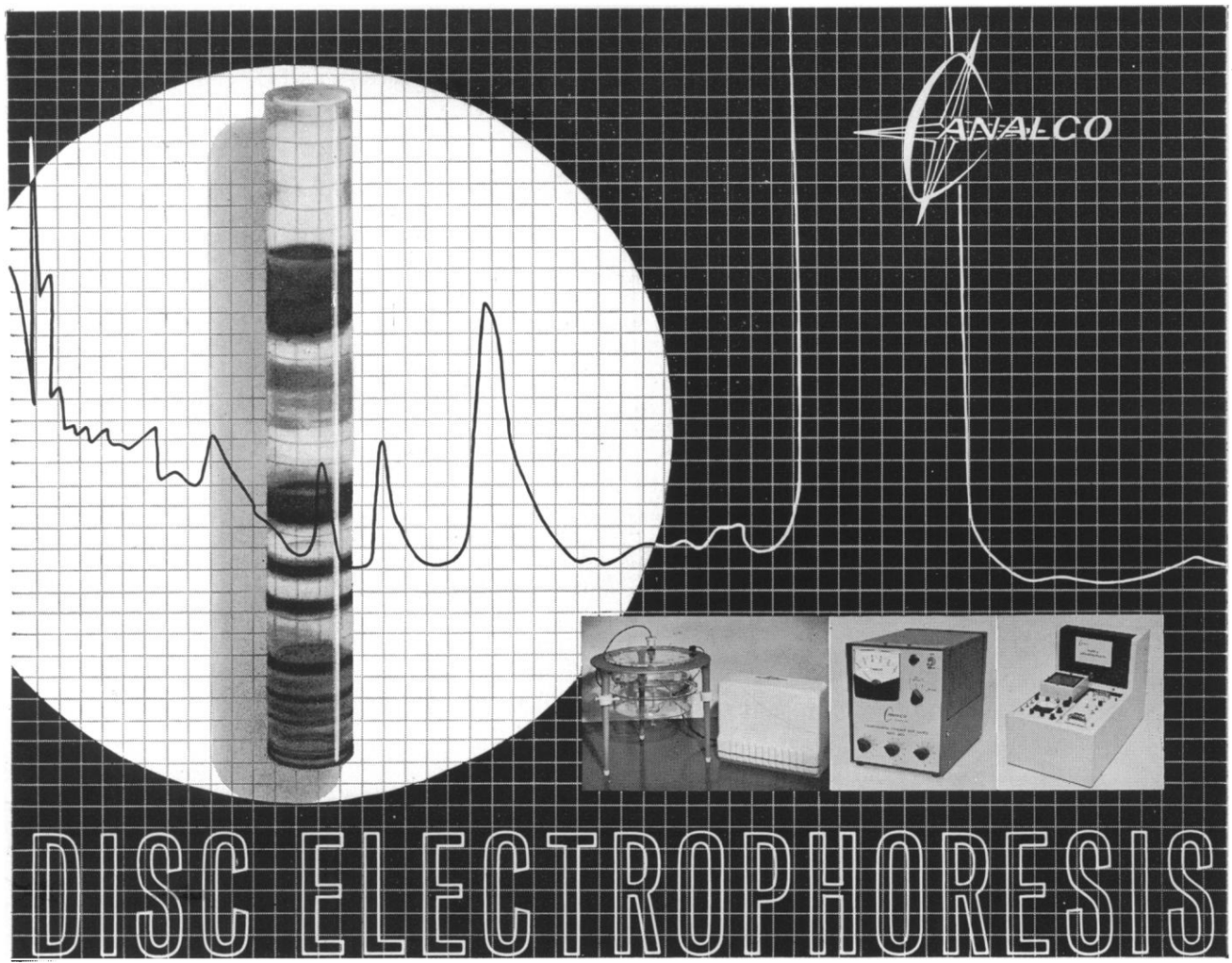
FEEL THE TOP OF A PYREX CYLINDER. We put extra glass around it and fire polish. On some models, we add a husky shoulder of glass to cushion against falls—it can't ride up and down, come off, or get lost. To make falls less likely and to reduce breakage if one should fall, we *weld* flatly pressed, hexagonal bases onto our cylinders.

TRY PYREX VOLUMETRIC FLASKS. Use them for six months and match them against *any* other. See if they don't give you longer life as well as accuracy. Heavy-neck tubing, skillfully sealed to machine-proportioned bodies, give you rugged units of strength.

*Du Pont trademark
†Licensed under U.S. Patent 2,876,985

CORNING

THE MAKERS OF PYREX® BRAND WARE



. . . resolves 0.01 ug protein . . . separates 20-30 protein fractions from human serum

One hundred times more sensitive than the starch gel technique, this powerful new method separates large molecular weight substances on 1½-inch long columns of a specially processed gel. More reproducible than either paper or starch, Disc Electrophoresis is also much faster — runs of ½ hour are typical instead of up to 12 hours. And you can actually watch the "front" move.

Twelve samples may be run at one time and results *quantitatively* evaluated with an exciting new microddensitometer which scans the gel columns directly, producing a chart record of the position and density of the various bands. Some typical protein separations have produced: *14 bands from brain extract (previously 3 by starch) / 4 sharp major hemoglobins (previously 3 blurred ones on paper) / 4 bands from frog embryo (previously 1 by starch).*

For details see your Aloe Scientific representative or write Aloe Scientific, ⊠ Division of Brunswick, 1831 Olive Street, St. Louis 3, Mo.

Aloe Scientific is your exclusive laboratory supply dealer for Canalco Disc Electrophoresis Apparatus

Serving the Sciences that Serve Mankind

ALOE SCIENTIFIC

tificial radiation belt produced by a recent nuclear explosion at great altitude is also being observed. The instruments in the satellite also measure galactic radio noise and the intensities of very-low-frequency radio emissions in the range 1 to 10 kcy/sec.

The design and construction of the satellite was carried out by the Canadian Defence Research Telecommunications Establishment with assistance from NASA (which was responsible for the final testing and launching of the equipment) and from Canadian industry.

The Alouette satellite represents a brilliantly successful effort in which international cooperation in scientific experiments in space may be seen working at its best.

J. O. THOMAS

Radioscience Laboratory, Stanford University, Stanford, California

Bibliography and Notes

E. S. Warren, "Sweep frequency radio soundings of the topside of the ionosphere," *Can. J. Physics* **40**, 1692 (1962).

"Alouette satellite 1962 Beta Alpha One" (Canadian Defence Research Board, Ottawa, 1962).

"Space Systems: Canada's Alouette. . . .", *Missiles and Rockets* (24 September 1962), p. 35.

The following papers were included among those presented at the URSI-IRE meeting: G. E. Lockwood, "Plasma and cyclotron spike phenomena observed in topside ionograms"; G. L. Nelms, "Scale heights of the upper atmosphere from topside soundings"; G. L. Nelms and E. S. Warren, "Diffusing electromagnetic radiation."

This paper is based on information presented in papers read at the URSI-IRE meeting in Ottawa, 15–17 Oct. 1962, by a number of Canadian scientists, and on discussions with J. H. Chapman, G. L. Nelms, J. S. Belrose, and G. E. Lockwood. Goddard Space Flight Center (NASA) provided Fig. 1 and a slide from which Fig. 2 was adapted.

Forthcoming Events

February

10–15. **Management** Function in Research and Development, conf., Pasadena, Calif. (Management Development Section, Industrial Relations Center, California Inst. of Technology, Pasadena)

11–14. American Soc. of **Heating, Refrigerating, and Air-Conditioning Engineers**, New York, N.Y. (R. C. Cross, 345 E. 47th St., New York 17)

11–14. Industrial **Lubrication**, intern. conf. and exhibit, London, England. (E. V. Paterson, Scientific Lubrication, 217a Kensington High St., London W.8)

11–15. Quantum **Electronics**, intern. symp., Paris, France. (Secrétariat, Troisième Congrès International d'Electronique Quantique, 7 rue de Madrid, Paris 8°)

12–14. **Lysozomes**, symp. (by invitation), London, England. (Ciba Foundation, 41 Portland Pl., London W.1)

13–15. **Electrochemistry**, 1st Australian

conf., part I, Sydney, Australia. (F. Gutmann, Physical Chemistry Dept., Univ. of New South Wales, Kensington, N.S.W., Australia)

13–16. National Soc. of College Teachers of **Education**, Chicago, Ill. (E. J. Clark, Indiana State College, Terre Haute)

14–15. American Soc. for **Quality Control**, Textile and Needles Trades Div., annual conf., Clemson, S.C. (H. F. Littleton, c/o Charles H. Bacon Co., Lenoir City, Tenn.)

15–14 Apr. **Aeronautics and Space**, intern. exhibition, São Paulo, Brazil. (Santos Dumont Foundation, Avenida Ipiranga N°. 84, São Paulo)

16–23. Caribbean **Dental** Convention, Port of Spain, Trinidad. (A. V. Awon, 43–45 Frederick St., Port of Spain)

17–21. Technical Assoc. of the **Pulp and Paper** Industry, annual, New York, N.Y. (TAPPI, 360 Lexington Ave., New York 17)

18–20. American **Standards** Assoc., natl. conf., New York, N.Y. (ASA, 10 E. 40 St., New York 16)

18–20. **Biophysical** Soc., annual, New York, N.Y. (A. Mauro, Rockefeller Inst., New York)

18–20. **Electrochemistry**, 1st Australian conf., part II, Hobart, Tasmania. (J. N. Baxter, Chemistry Dept., Univ. of Tasmania, Hobart)

18–25. Expert Committee on **Food Additives**, FOA/WHO, Rome, Italy. (Intern. Agency Liaison Branch, Office of the Director General, Food and Agriculture Organization, Viale delle Terme di Caracalla, Rome)

19–22. **Radiochemistry**, inter-American conf., Montevideo, Uruguay. (Pan American Union, Washington 6)

20–22. Fundamental **Cancer** Research, annual symp., Houston, Tex. (L. Dmochowski, Section of Virology and Electron Microscopy, M. D. Anderson Hospital, Houston 25)

20–22. **Solid-State Circuits**, intern. conf., Philadelphia, Pa. (F. J. Witt, Bell Telephone Laboratories, Inc., Murray Hill, N.J.)

20–23. National Assoc. for Research in **Science Teaching**, Washington, D.C. (J. D. Novak, Biological Science Dept., Purdue Univ., Lafayette, Ind.)

20–24. Diseases of the **Chest**, intern. congr., New Delhi, India. (M. Kornfeld, American College of Chest Physicians, 112 E. Chestnut St., Chicago 11, Ill.)

21–22. American Soc. for **Quality Control**, regional conf., Las Vegas, Nev. (S. R. Wood, Dept. 61, Bldg. 160, Aerojet-General Corp., Azusa, Calif.)

22–23. American **Psychopathological** Assoc., annual, New York, N.Y. (F. A. Freyhan, c/o St. Elizabeths Hospital, Washington 20, D.C.)

23–28. American Soc. for **Testing** and **Materials**, Atlantic City, N.J. (H. H. Hamilton, 1916 Race St., Philadelphia 3, Pa.)

24–25. Unit Processes in **Hydrometallurgy**, symp., Dallas, Tex. (F. T. David, Colorado School of Mines, Golden)

24–27. **Diffusion**, intern. conf., Palm Springs, Calif. (J. A. Biles, Univ. of Southern California, School of Pharmacy, Los Angeles 7)

24–28. American Inst. of **Mining, Metallurgical, and Petroleum Engineers**, annual, Dallas, Tex. (E. Kirkendall, AIME, 345 E. 47 St., New York 17)

25–27. Advanced **Marine Engineering** Concepts for Increased Reliability, symp., Ann Arbor, Mich. (G. L. West, Jr., Dept. of Marine and Nuclear Engineering, Univ. of Michigan, Ann Arbor)

25–1. **Environmental Engineering**, natl. conf., Atlanta, Ga. (W. H. Wisely, American Soc. of Civil Engineers, 345 E. 47 St., New York, N.Y.)

26–27. **Dairy Engineering**, natl. conf., East Lansing, Mich. (C. W. Hall, Dept. of Agricultural Engineering, Michigan State Univ., East Lansing)

26–1. Society of **Plastics Engineers**, annual technical conf., Los Angeles, Calif. (G. P. Kovach, Foster Grant Co., 289 N. Main St., Leominster, Mass.)

27–3. American College of **Cardiology**, Los Angeles, Calif. (P. Reichert, 350 Fifth Ave., New York 1, N.Y.)

28–2. Experimental Aspects of **NMR Spectroscopy**, Pittsburgh, Pa. (W. A. Straub, Applied Research Laboratory, U.S. Steel Corp., Monroeville, Pa.)

March

1–3. **Developing Brain and Binding Sites** of Brain Biogenic Amines, intern. symp., Galesburg, Ill. (H. E. Himwich, Research Div., Galesburg State Research Hospital, Galesburg)

2–6. Canadian Assoc. of **Radiologists**, annual, Quebec, Canada. (J. L. Léger, 1555 Summerhill Ave., Montreal 25, P.Q., Canada)

4–6. Association of **Iron and Steel Engineers**, western meeting, Los Angeles, Calif. (T. J. Ess, 1010 Empire Bldg., Pittsburgh 22, Pa.)

4–6. **Wildlife Management** Inst., Detroit, Mich. (C. R. Gutermuth, 709 Wire Bldg., Washington 5)

4–8. **Analytical Chemistry and Applied Spectroscopy**, 14th annual, Pittsburgh, Pa. (W. A. Straub, Applied Research Laboratory, U.S. Steel Corp., Monroeville, Pa.)

4–9. **Astronautics**, 3rd Inter-American symp., São Paulo, Brazil. (Symp. Secretariat, Sociedade Interplanetaria Brasileira, Caixa Postal 6450, São Paulo)

5–7. **Plant Engineering and Maintenance**, 4th southeastern seminar, Charlotte, N.C. (A. Brown, Service Engineering Associates, Inc., P.O. Box 2665, Atlanta, Ga.)

5–8. Committee on **Textile Materials**, New York, N.Y. (American Soc. for Testing and Materials, 1916 Race St., Philadelphia 3, Pa.)

5–9. Application of **Radioisotopes in Hydrology**, symp., Tokyo, Japan. (IAEA, 11 Kärntner Ring, Vienna 1, Austria)

6. American Assoc. of **Psychiatric Clinics for Children**, annual, Washington, D.C. (American Psychiatric Assoc., 1700 18th St., NW, Washington 9)

6–9. American **Orthopsychiatric** Assoc., annual, Washington, D.C. (American Psychiatric Assoc., 1700 18th St., NW, Washington 9)

7–9. German Soc. of **Endocrinology**, 10th symp., Vienna, Austria. (H. Nowakowski, Deutsche Gesellschaft für Endokrinologie, c/o II. Medizinische Universitätsklinik, Hamburg-Eppendorf, Germany)

9. **Linguistics**, 8th annual, New York, N.Y. (L. Pap, State Univ. College, New Paltz, N.Y.)

10–13. American Inst. of **Chemical Engineers**, New Orleans, La. (J. Henry, 345 E. 47th St., New York, N.Y.)

10–20. **Nutrition** Problems in Latin America, 5th U.N. Food and Agriculture Organization conf., Lima, Peru. (Intern. Agency Liaison Branch, Office of the Director General, Viale della Terme di Caracalla, Rome, Italy)

11–16. Numerical **Weather Forecasting**, World Meteorological Organization/International Union of Geodesy and Geophysics, intern. symp., Oslo, Norway. (World Meteorological Organization, Geneva, Switzerland)

14. Assoc. of **Vitamin Chemists**, Chicago, Ill. (H. C. Spruth, Abbott Laboratories, 14th and Sheridan, North Chicago)

14–15. Advanced **Air-Cooled Reactor**, symp., London, England. (Secretary, British Nuclear Energy Soc., 1–7 Great George St., London, S.W.1)

14–15. Central **Neuropsychiatric Hospital** Assoc., annual, Chicago, Ill. (American Psychiatric Assoc., 1700 18th St., NW, Washington 9)

15–16. Pacific **Computer** Conf., Pasadena, Calif. (E. Schubert, Systems Div., Beckman Instruments, 2400 Harbor Blvd., Fullerton, Calif.)

17–24. **Military Medicine and Pharmacy**, 17th intern. congr., Caracas, Venezuela. (Organizing Committee, c/o Dirección del Servicio de Sanidad Militar, Hospital Central de las Fuerzas Armadas, Urbanización San Martín, Caracas)

18–22. American Soc. for **Metals**, western metal exposition and congr., Los Angeles, Calif. (W. J. Hilty, ASM, Metals Park, Ohio)

18–28. International **Astronomical** Union, 20th symp., Canberra, and Sydney, Australia. (D. H. Sadler, c/o Royal Greenwich Observatory, Hertsmonceux Castle, Hailsham, Sussex, England)

20–22. **Bone Dynamics**, intern. symp., Detroit, Mich. (H. M. Frost, Dept. of Orthopaedic Surgery, Henry Ford Hospital, Detroit 2)

20–29. **Quantitative Spectroscopy** at Elevated Temperatures and Selected Applications in Space Science, Pasadena, Calif. (D. L. Wennersten, Air Force Office of Scientific Research, Washington 25)

21–24. International Assoc. for **Dental Research**, 41st annual, Pittsburgh, Pa. (J. Muhler, 1120 W. Michigan St., Indianapolis 2, Ind.)

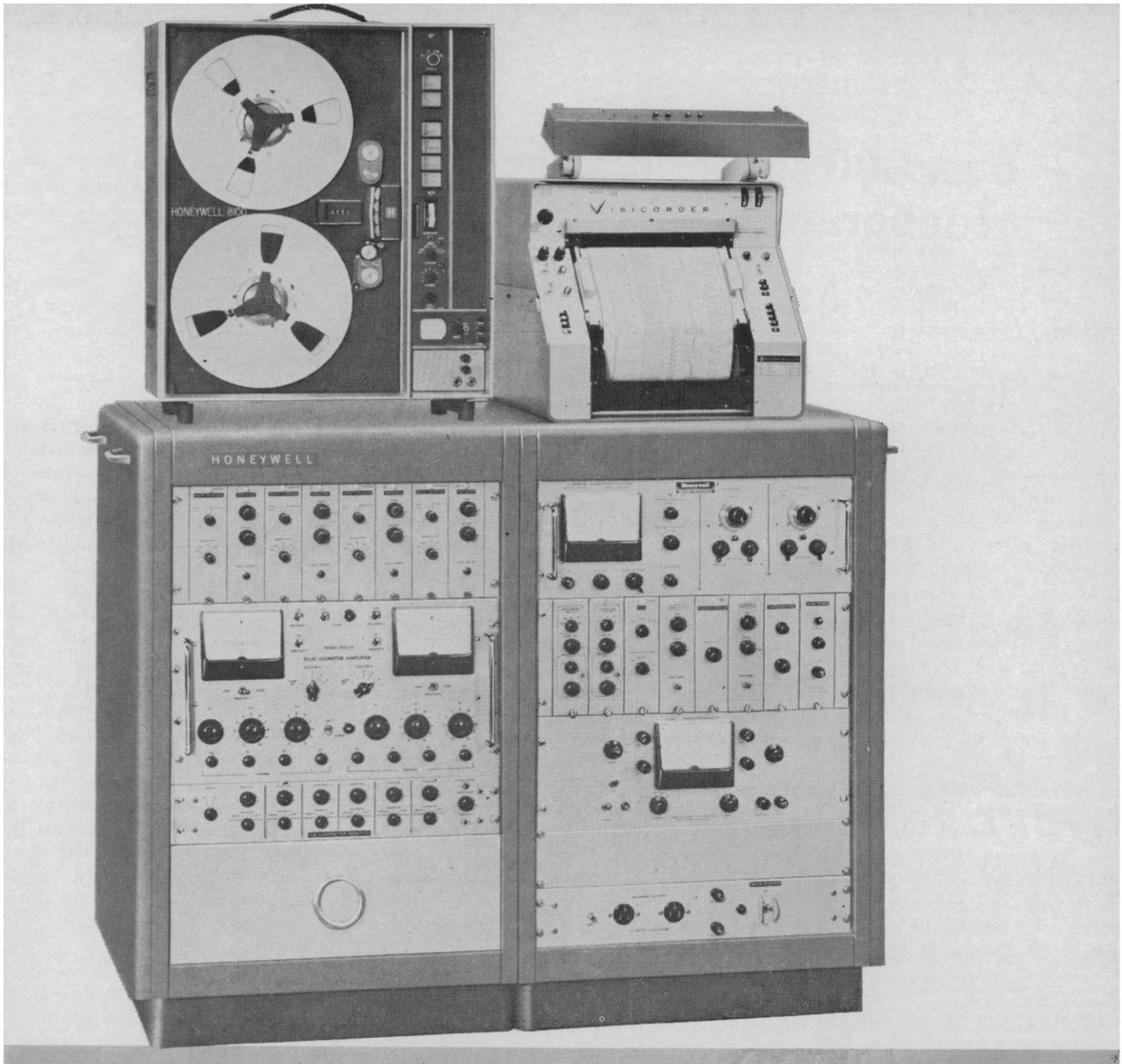
21–24. International College of **Applied Nutrition**, Pasadena, Calif. (D. C. Collins, 7046 Hollywood Blvd., Suite 503, Los Angeles 28, Calif.)

24–28. Institute of **Radio Engineers**, intern, convention. New York, N.Y. (G. W. Bailey, 1 E. 79 St., New York)

25–27. High Frequency **Communication**, convention, London, England. (Secretary, Institution of Electrical Engineers, Savoy Pl., London, W.C.2)

25–28. American Assoc. of **Petroleum Geologists**, 48th annual, Houston, Tex. (J. M. Parker, Kirby Petroleum Co., 518 Patterson Bldg., Denver 2, Colo.)

25–28. Society of Economic **Paleontologists and Mineralogists**, Houston, Tex. (L. C. Pray, Ohio Oil Co., Box 269, Littleton, Colo.)



HONEYWELL 8100 . . . A NEW LABORATORY TAPE RECORDER WITH INTEGRAL ELECTRONICS FOR MEDICAL DATA ACQUISITION

The new instrument in this array of Honeywell Electronic Medical System equipment is the 8100 FM Portable Tape Recorder (upper left). Unlike other instrumentation recorders in its price and applications class, it contains *all* of its own electronics—including built-in calibration instruments. The 8100 features one to eight data channels, in addition to compensation and voice channels; IRIG configuration is available. It records all physical phenomena from DC to 10,000 cycles with the fidelity of FM and reproduction quality of the largest non-portable instruments. Yet its price is extremely reasonable, ranging from $5900 to $11,300. You will use it in many places other than the laboratory, too—it's truly portable: only 75 pounds!

Send for 8100 brochure to Honeywell, Electronic Medical Systems, P.O. Box 8776, Denver 10, Colorado.

Honeywell

Electronic Medical Systems

ness and superficiality but is fundamentally anti-evolutionist in emphasis, despite assertions to the contrary. I agree with Ehrlich and Holm that "perpetuation of today's theory as dogma will not encourage progress toward more satisfactory explanations of observed phenomena." Unfortunately, in view of their methodological bias and paucity of theoretical principles, it is difficult to see how they are going to be more successful than other biologists in studying the "pattern in which organisms are related in space and time." To judge from the magnitude of operationalist achievements so far, it would seem premature to knell the demise of the biological species concept and to proclaim the approach of a "non-Euclidean" theory of classification. In the words of Rothstein, a hard-boiled operationalist (*11*): "we believe that lack of progress in non-physical disciplines where attempts have been made to introduce operational definitions results from the lack of well-defined laws. . . . Operational definitions . . . are necessary rather than sufficient conditions for progress."

GRADY L. WEBSTER
Department of Biological Sciences,
Purdue University,
Lafayette, Indiana

References

1. D. Amadon, *Science* **138**, 733 (1962).
2. P. R. Ehrlich and R. W. Holm, *ibid.* **137**, 652 (1962).
3. P. W. Bridgman, *The Logic of Modern Physics* (Macmillan, New York, 1927).
4. ———, *Sci. Monthly* **79**, 224 (1954).
5. R. B. Lindsay, *ibid.* **79**, 221 (1954).
6. E. Mayr, Ed., "The Species Problem", *Publ. Am. Assoc. Advan. Sci. No. 50* (1957).
7. G. G. Simpson, *Principles of Animal Taxonomy* (Columbia Univ. Press, New York, 1961).
8. P. H. A. Sneath and R. R. Sokal, *Nature* **193**, 855 (1962).
9. J. G. Edwards, *Systematic Zool.* **11**, 142 (1962).
10. J. S. L. Gilmour, *Nature* **168**, 400 (1951).
11. J. Rothstein, *Phil. Sci.* **29**, 406 (1962).

We admit that our thinking, like that of virtually all present-day scientists, has been influenced by the writings of Bridgman. This does not mean that we embrace operationalism as a philosophy of science, for it does not represent a philosophy and was not proposed as such. Our attitude is well summed up by Rothstein: operational definitions are necessary but not sufficient conditions for progress. Much useful theoretical structure in biology (for example, various ideas about the origin of life, the general theory of evolution) is not amenable to direct operational analysis. However, valid concepts which are formally integrated into such a theo-

retical framework must be verifiable empirically. Such empirical verification requires operational definition. The interesting assessment of operationalism by Lindsay does not seem germane to this discussion. Concepts such as "species," "niche," and "community" have not been used by biologists as abstruse theoretical constructs linkable only indirectly (or perhaps not at all) with observations. It would be entirely fair to say that many biologists are under the impression that species, niches, and communities are *things observed*. If these concepts are to be useful to biologists, their operational definition is a *sine qua non*.

It is obvious to anyone that words such as *community* are acceptable and useful in many contexts (as we discussed with reference to *tundra*). It is when they are used, as they almost inevitably seem to be, as labels for presumptive general units that operational definitions must be formulated. That this is a problem should be clear in view of the prevalent discussions of community "migration" or biome "phylogeny." The problem is no less difficult with respect to "species." There are numerous definitions of biological species in the literature, but none is operational, since they all include the idea of "potential interbreeding" and this cannot, by definition, be tested. Indeed, theoreticians have been unable to establish a satisfactory measure of actual interbreeding, although one might hope such a standard may eventually be devised. Many modern taxonomists "feel" that biological species exist (at least in diploid out-crossing organisms); they take the point of view that the principal difficulty is in finding or delimiting them (although virtually every well-studied case turns out to be "borderline" or "a problem"). The attempt to force all organisms (including apomictic and allopolyploid plants) into the "biological species" is as common as it is indefensible.

The problem of typology has been dealt with in great detail by Sokal (*1*), who points out that it is improper "to attach automatic derogatory implications to the adjective 'typological,' since it is only those aspects of typological procedure which cannot be defended or maintained today that would merit such a connotation." Daly (*2*), in another analysis of the problem, states, "It is now clear that the phyletic approach has perpetuated the most undesirable attributes of classical typology: the need for a fundamental char-

acter and the intervention of personal judgment in the event none can be discovered." The typological approach has been employed in biology in many different ways. It is clear that when it forms the basis of a philosophical system seeking to establish the existence of nonmaterial "types" it would have little appeal for the modern biologist. However, a statistical average is a type, but this does not limit its usefulness, make its use old-fashioned, or align the statistician philosophically with Plato.

We must agree with Webster that increased objectivity and repeatability are great advantages of numerical taxonomy. Indeed, a discipline which does not achieve such goals to a reasonable degree does not merit the appellation "science." This, in part, is "what has been gained . . . for all the time and expense of data programming and computer analysis." (We might point out that numerical taxonomic computer programs are available at no charge, and that many major universities make computer time available to faculty members without charge if no funds are available. For many studies the cost of computer time would be much less than $100.)

We must also point out that the techniques of numerical taxonomy hold promise of doing much more. For instance, it seems that developmental questions such as whether or not the system of phenetic relationships among larval beetles is congruent with that among adult beetles will finally be settled. As another example, the study of relationships of individuals (as in the much-maligned pilot study mentioned later) may permit the creation of a "population phenetics" which will add new dimensions to the study of microevolution. Perhaps the most fortunate aspect of numerical taxonomy is that it may open the door to a general taxonomy—one not restricted to classification of organisms but applicable to such diverse things as soils, automobiles, stellar systems, or any other collection of objects one desires to classify on the basis of any set of characteristics.

Webster's statement that phenons "may be 'rigged' at the proper percentage level to make them *approximate natural taxonomic* groups" (our italics) is very revealing. It is only possible to "rig" something when one has a preconceived idea of what it should be rigged to fit. Numerical taxonomists urge that groups be constructed with-

out the use of intuition or of preconceived notions of phylogeny. Once groups are established they may be scrutinized in an attempt to discover the biological reasons for their existence. The basic data of the taxonomist are the similarities of the entities with which he deals. Preconceptions should not be permitted to bias the gathering of these data. At any rate, the phenon concept in numerical taxonomy is a device for avoiding long, meaningless discussions revolving around what status should be given to a group (is it a genus, subgenus, subfamily, and so on?). Phenon level, therefore, has nothing at all to do with the "naturalness" of groups, and the phenon level may be "rigged" as convenience dictates. Indeed, phenons could be established in a classification based on the frequency with which various letters appear in the scientific name of the organism—a system which almost all biologists would consider "unnatural" because of the extreme paucity of biological information that it would contain.

The contention by Webster (and Edwards) that Ehrlich judges the biological species concept on the basis of an analysis of 13 specimens is very difficult to understand. In the paper in question (*3*) all 94 genera of North American butterflies are discussed, as well as information from other animals and plants. The section dealing with the 13 specimens is introduced with the statement, "In order to test the hypothesis that numerical analysis will not cluster individuals by population, a pilot study was undertaken in which the similarities of an array of individual butterflies were evaluated." In other words, this pilot study was undertaken merely to discover whether individuals within a local population were all more similar to each other than they were to any individual from outside that population. As soon as an individual is discovered to be more similar to an individual from another population than to one from its own population the question is answered. Thirteen individuals were ample for a pilot test of this hypothesis, as the addition of more individuals to the study would merely have expanded the *Q*-matrix, not altered any of the values in the original matrix. These individuals were not considered samples from a larger set of items, they were the units being compared.

Weighting of characters has been dealt with extensively in the literature

(for example, *1*, *4*), and no logically defensible system of weighting has yet been advanced by the proponents of the idea that some characters are a priori "more important" or "more basic" than others. There is no reason why information from the genetic system cannot be used in numerical comparisons. However, at this stage it must be asked, In what way is degree of chromosome pairing "more important" than degree of hairiness? It is known that, in diverse organisms, the first may be controlled by a single gene (*5*), as may the latter. But inasmuch as single genes, as well as balanced polygenic systems, may affect gross morphological characters we find it hard to see how such evidence may be employed in a system of weighting. Are we to imply from Webster's letter that the "sound theoretical basis" for weighting of characters is the "experience of most competent systematics"?

Few taxonomists (classical or numerical) have attempted to remove the environmental component and deal only with the genetic variation in their material, for obvious practical reasons. Webster seems to feel that taxonomy ideally would deal only with additive genetic variance, but there is some theoretical question as to whether this would be desirable even if it were practical.

In no place do we suggest a " 'non-Euclidean' theory of classification," although the idea may have merit. We have suggested that the present strong interlocking of taxonomy and evolutionary theory may inhibit the development of a "non-Euclidean" theory of evolution. This does not mean that we decry the existence of taxonomy or repudiate the present theory of evolution. We would not, however, wish to be placed in the position of having to affirm a "belief" in evolution.

Today biological evidence seems overwhelmingly in favor of the neo-Darwinist view of evolution. Therefore it is especially important for us continually to re-examine its most fundamental tenets. In our article we wished merely to point out that certain problems might be viewed in different perspective. We had no intention of retroactively supplanting one approach with another, even if that were in some way possible. When it appears that a road is blocked because the cart is before the horse, there are two possible courses of action. One is to blow up the horse and cart. The other is to send an exploring party up a nearby path while the road is being cleared. We wished to suggest the second alternative.

PAUL EHRLICH
RICHARD W. HOLM
Division of Systematic Biology,
Stanford University,
Stanford, California

References

1. R. R. Sokal, *J. Theoret. Biol.* **3**, 230 (1962).
2. H. V. Daly, *Systematic Zool.* **10**, 176 (1961).
3. P. R. Ehrlich, *ibid.* **10**, 167 (1961).
4. ———, *ibid.* **7**, 183 (1958); P. H. A. Sneath and R. R. Sokal, *Nature* **183**, 855 (1962).
5. H. Gaul, *Z. Abst. Vererb.* **86**, 69 (1954).

A Grain of Skepticism

"What is really needed is more of that healthy skepticism which generates the key idea . . ." [*Science* **138**, 75 (1962)].

Allow me to apply a germ of skepticism to this statement. At just what point did skepticism generate a key idea in the xenon tetrafluoride synthesis case?

I suspect that Neil Bartlett would report that skepticism as such had nothing to do with it. How was the key idea generated? It would be interesting—and surely it is important—to know.

BURNETT CROSS
170 East Hartsdale Avenue,
Hartsdale, New York

. . . one must agree that "the essential ingredient in discovering xenon tetrafluoride was not money or equipment," but one must conclude that an essential ingredient was people—17 of them.

J. W. WETZEL
Hotpoint Division,
General Electric Company,
Chicago, Illinois

. . . seventeen scientists signed their names to an article that required only "a few hours of effort and a germ of skepticism." I am sure that the salaries for 17 scientists come to a very much greater figure than many elaborate pieces of scientific equipment.

JULIUS H. COMROE, JR.
San Francisco Medical Center,
University of California

I suppose that I am not alone in feeling that the editorial "The need for skepticism" points a finger at me, along

with the rest of the million scientists referred to.

Much as I agree with the motivation for this editorial, I am afraid I must disagree with its content pretty severely. The "germ of skepticism" certainly existed in at least two groups referred to by the authors of the report in question. In fact, Yost and Kaye tried the specific elements xenon and fluorine. The fact that they happened to do the wrong experiment was just a break of the game. In my own notebook, in early February 1956, I jotted down "Krypton Fluoride—does it exist?" This was not a speculation out of the blue, but grew out of some thinking I had been doing on electron affinities in connection with my work on static electrification. It seemed clear that the electron affinity of fluorine might be great enough to pull an electron out of a stable rare gas of large diameter. In the same vein, I had considered that cesium helide might exist, but only in a metastable form, since the helium negative ion does not exist in the ground state. I even suggested to one of my colleagues in molecular spectroscopy that he might look for these two substances.

Surely dozens, if not hundreds, of my colleagues in various fields have had similar ideas. Our reasons for not dropping everything to search for these new compounds were not that we lacked the idea or were bound by dogma but that we had only finite resources and had to devote our efforts to what seemed promising and feasible in terms of our experience and commitments. Any of us has an idea or two every day that we should like to follow up, but cannot because of practical limitations.

Abelson evidently had tongue in cheek when he said that it would take only a few hours of effort to perform the experiment. Even if the experimenter knew exactly what to do, he could hardly assemble in a few hours an experimental setup that would permit him to heat elemental fluorine to 400°C! In fact, one might make the point that it was availability of facilities for handling difficult chemicals that made it possible for the Argonne group to carry out their experiments, rather than an excess of imagination. This is all to the good, of course, and I often point out to my students that in going to government laboratories they will have unique facilities.

The Argonne group, together with Neil Bartlett, is certainly to be congratulated for excellent work on a stimulating idea. I don't feel that it is fair to

indict all the rest of us because we did not drop everything and turn our attention to this problem, or to underrate the investment in facilities necessary to carry out the experiments under discussion.

D. J. MONTGOMERY
Department of Physics and Astronomy, Michigan State University, East Lansing

Perhaps I underestimated the experimental difficulties others might find in conducting the reaction of fluorine and xenon and can speak best for myself. I conducted experiments involving fluorine at temperatures above 400°C during the days when experimenters generated their own gas, and I personally observed that an excellent containing vessel can be made from nickel. For the last two years xenon and fluorine gas have been on hand in my laboratory. We have excellent shop facilities at the Geophysical Laboratory [Washington, D.C.], and the fabrication of necessary experimental equipment merely required a request on my part. Thus, all that was needed for me to make the discovery was a dose of the medicine I have prescribed—a grain of skepticism.—P.H.A.

Dictionaries and Language

Although I greatly admire Warren Weaver, and have for a long time, I feel I must oppose the unrealistic viewpoint he expresses in regard to language [*Science* **137**, 1025 (1962)].

He is much mistaken, I believe, in making analogous use of the particular biological fact he cited in order to indicate how we should communicate as human beings. It is fascinating, but not relevant, that genetic communication is so precise and generally so devoid of error that it rarely allows the introduction of deviation or mutation.

With men, living in the complexities of modern society, communication cannot possibly be so stablized, so simplified, and so free of ambiguity—at least, not until there is complete, global cultural homogeneity, with universality of thinking, language, and responses (and probably not even then).

In our society we speak as we live: according to our roles. Our roles are many, and the ways we use speech are as numerous. One may be a physicist, gardner, husband, father, lover, do-it-yourselfer (don't flip your lid, sir!),

birder, surfer, hiker, biker, piker, Scout leader, discussion-group chairman, and much more, all more or less contemporaneously and with no trouble at all. And each of these roles requires a different use of language if the role-player is "with it."

There is no more hopeless aim than that of arresting the pattern of language so that it may be definitively fixed in a dictionary, like insects in amber. Especially is this so in times like ours, when change is the dominant universal and is proliferating exponentially.

The main trouble with Weaver's way of looking at language is that it ignores the facts of linguistics. Several years ago, in *The Miracle of Language,* Charlton Laird was very specific in declaring that the fundamental principle of language is that it constantly changes. He also took the position that it should not change so rapidly as to lose currency. However, there isn't much danger that this will happen, he said, for the simple reason that innumerable nonofficial agencies—newspapers, broadcasters, bureaus, and schools—are all assiduously asserting themselves as to what is correct. Indeed, the urge to be "right" is so strong that, where words have two spellings or two pronunciations, our multitudinous seekers after correctness demand to know which is preferred and scorn the nonpreferred.

There is little recognition of the fact that dictionaries come to us not from on high, or from any supreme court of lexicography, but from scholars who may, and often do, differ. Dictionaries record the speech of the day and often specify whether it represents English that is formal, informal, vulgate, or colloquial. This should be enough in the way of mirroring the usage of the moment.

Probably the most revealing misconception of Weaver's plea for language stability is the one revealed in his phrase, "Human words should change occasionally. . . ."

It is not a matter ever, of what human words should or should not do, when it comes to change. If today's pace of change is the fastest in world history, how can word change be confined to "occasionally"? King Canute did not occupy himself more futilely than those who would stem the tide of change in language.

ARNOLD B. LARSON

1457 5th Street,
Manhattan Beach, California

Warren Weaver's excellent remarks have long been needed. When we alter our language we should be sure that we are progressing, not retrogressing. . . .

F. BRUCE SANFORD
U.S. Fish and Wildlife Service, Seattle, Washington

I was delighted to read Warren Weaver's editorial making a plea for a return to good English and away from the sloppy, slipshod, and short-cut methods used by many today. . . .

FREDERICK D. ROSSINI
University of Notre Dame, Notre Dame, Indiana

. . . I agree thoroughly with Weaver's viewpoint. . . . The mere use of certain incorrect words . . . or the lack of certain forms of punctuation in writings of many people is no basis for making that . . . "correct."

A. A. FLEMING
College of Agriculture, University of Georgia, Athens

. . . The precision of a language generally reflects the mental precision of the users of that language. . . .

FRED PLUM
Department of Medicine, University of Washington, Seattle

Dominance of the Military

It is easy, at this stage of the societal sciences, to contest any general theory of social causes, and it is equally easy to accuse Fred Cook of holding the same bogeyman image of the military that he says the military holds of the Soviet Union [*Science* **138**, 797 (1962)]. If Cook meant to imply that the military establishment and its prime contractors are the single, hidden, omnipotent, and irresistible determinant of all major policy choices he would be wrong, and D. S. Greenberg's critique would be appropriate. If, on the other hand, he is claiming that a certain type of amoral strategic thinking (pioneered by the military) and a certain set of expectations for the cold war (engineered by the press and by industry) have been gradually encapsulating even those who consider themselves quite removed from the military, his case seems sound. Educators, scientists, and backers of many forms of civil-rights and social-welfare measures now feel impelled to justify their endeavors by citing the potential value of these en-

deavors to the cold war. Even the peace groups argue for one form of deterrence in preference to another, and the assumption that the Soviets intend to risk evasion of a test ban, should one be agreed on, is rarely if ever questioned.

While informed liberals rejoice at the passing of the McCarthy era, a college president hastily dismisses a college professor for protesting the naval blockade, and the press, of its own accord, restricts coverage of antimilitary views and activity. Reasonable nonmilitary men now claim that American military aggression against Cuba is right, while protesting a history of similar Russian moves. Adlai Stevenson, no military prototype, now defends the double standard for overseas missile bases, and the concept of brinksmanship, once a political liability, has become a prerequisite of political viability. Even the U.S. Arms Control and Disarmament Agency, which the Department of Defense has supported consistently, falls into the safe pattern of sponsoring research which is restricted to technical problems or which is based on the assumption, not on evidence, that strategic thinking offers answers to questions of policy.

Greenberg shows that we are still in a strongly pluralist society and that the military establishment itself is neither monolithic nor uniquely potent in its endeavors. But it is not the potential for military dictatorship of 9 million members of Birch-type organizations which worries me most. Far more insidious than the known and hated dictator is the establishment's wide sowing of seeds of fear, hate, and worship of cold efficiency throughout the culture. And it is we, not the dictators, who insure the annual increase in military appropriations and in the sphere of influence of the military. It is the intellectual community which now stands paralyzed in a drift toward war.

The real test of military dominance is not whether a President (who was a former general) could lessen military pressures to break the testing moratorium, or whether the Air Force asks for even more than it receives, but whether any force, hidden or open, can stem the growth of the power and thought of the military before these create the conditions which necessitate a major, unwanted war. If I were suddenly to see all the economic gravy that is going into counterforce dramatically converted into credits to underdeveloped countries to buy American food and hard goods; if I were to see industrial states such as Michigan, which have lost the arms race, winning the peace race, then I would be happy to applaud corrections of Cook's exaggeration. Till then, the warning is critical. Patterns plainly observable in our own culture are the "invisible hand" of the gods of war.

MARC PILISUK
Department of Psychiatry,
University of Michigan, Ann Arbor

Greenberg's "Who runs America?" is an able presentation of convincing evidence. I wonder though if he is not missing the real point—which is, as I see it, that the military-industrial complex is not a faceless monster in the Pentagon but a way of life and a frame of mind which includes you and me and the guy across the street. The question should, perhaps, be not "Who Runs America?" but "What Runs America?"

It is beside the point to argue that we have not launched an all-out war against the U.S.S.R. or that we may differ as to the maximum amount that it is practical to raise by taxation, or that Birch-ites and white supremacists do not get everything they want, or that some generals have sometimes been restrained. Very much *to* the point is the fact that liberals and conservatives, rich and poor, white and black. Northerners and Southerners, farmers and city dwellers, take it for granted that an increase in military spending is the proper response to every challenge and that they will fight, shoulder to shoulder, any attempt to dismantle even the most archaic military installation in their area or to cancel the most useless contract for military hardware made in their state. We may disagree as to how the pie should be cut, but we never question the need for an ever-larger pie.

We think of the United States as a peace-loving, friendly, altruistic champion of freedom and democracy. We shall some day have to face the fact that we are the most formidable military power that ever existed—and probably the nation which has done more than any other nation in history to militarize the entire world. The Chinese who are now attacking India are using the training—and probably the weapons—which we gave them to defeat

communism. The Latin-American nations, which feel that they must choose between progress and catastrophe, are pointing out that the millions we gave them have just about covered the cost of the military establishments we have urged upon them. In Cuba, as in China, we helped an unpopular, undemocratic, and corrupt military dictatorship eliminate every alternative to communism—and then wondered why communism took over. It is largely because of our subsidies that Germany has been remilitarized, and that France is ruled by one general who spends most of his time struggling against other generals.

The fact that we are not at war does not prove the impotence of our military establishment: most military leaders sincerely want peace. It was said of Hitler, though, that he did not want war—he merely insisted upon the fruits of victory. It may be said of us that we did not want war—we merely insisted upon an all-out armament race. The question is, Can we have the one without the other?

WILLIAM PALMER TAYLOR
416 Ross Avenue, Hamilton, Ohio

The Dispassionate View

D. S. Greenberg's account of the Cuban crisis (9 Nov., p. 670) does not reflect the dispassionate, even-handed treatment of data which one expects in the pages of *Science*. I have reference to statements such as "the Soviet gambit in Cuba reflects a capacity for deceit that will amply support those who contend that the Soviets cannot be trusted . . . ," or "Bits and scraps of . . . diplomatic intercourse . . . do nothing to improve the Soviets' badly tarnished reputation for veracity."

Both Walter Lippmann and the New York *Times* reporter Max Frankel published accounts of the famous meeting of Kennedy and Gromyko of 18 October, 4 days before the United States imposed its quarantine. According to both sources, Kennedy never confronted the Soviet foreign minister with evidence of the missiles and bombers in Cuba, even though in his address to the nation the President claimed that the evidence was in his possession at that time. Furthermore, the President told Gromyko that the United States was basing its attitude on the assumption that the build-up of Russian arms in Cuba was defensive. Other New York *Times* articles revealed that, prior to the Kennedy-Gromyko meeting, the administration was actively lining up support for a move against Cuba. Duplicity was not confined to one side.

Psychologists and anthropologists have for years called attention to perceptual distortions resulting from ethnocentrism. The actions of in-group members are viewed with compassion if not with esteem, while the same actions displayed by members of the out-group are seen as unjust and reprehensible. As scientists, it is incumbent upon us to recognize this biasing of perceptions, and to take appropriate control measures to negate the effects. This is no less a responsibility in the area of international relations than it is in the laboratory where the ethics of science compel us to view both the positive and the negative evidence with respect to hypotheses. Greenberg's article fails in this respect, from my point of view.

Fortunately, Greenberg provides a clue to one of the essential conditions that may assist in bringing about a healthier relationship between the major powers and reduce perceptual distortions across international boundaries. A portion of his article is an evaluation of the "black box" system for policing a nuclear test ban. He says, "It is felt that in an atmosphere of *trust*, the black box approach would do nicely for verifying observance of an underground test ban. But if the duplicity involved in the Cuban operation is any indication of Soviet *trustworthiness*, the difficulties that frequently attend the operation of complex equipment could easily set off charges of bad faith and deception" (italics added). May I suggest that the development of trust cannot be guaranteed by any treaty, but underlies all treaties. It grows by evidences of trust initiated by one party and reciprocated by the other. As scientists, we can contribute toward the development of this essential ingredient of arms control by taking a less ethnocentric view of ourselves, and by carefully assessing data indicative of duplicity or integrity on the part of the opposition.

F. KENNETH BERRIEN
Department of Psychology, Rutgers University, New Brunswick, New Jersey

Berrien is contending that the United States is guilty of duplicity because it did not notify the Russians that it was aware of their attempts at deception. It is possible that he has ascended to a

height where he can view events with unusual dispassion and wisdom, but I do not understand what he is talking about. The fact is that the Russians, under a cover of soothing assurances, attempted to improve their strategic position; the U.S. did not broadcast its knowledge of the situation until it was in a position to do something about it. It is hard for me to see how this sequence of events can support the conclusion that "duplicity was not confined to one side."—D.S.G.

Photo-oxidation Systems with Added Iodine

Some effects of iodine in dilute photochemical reaction systems containing olefins and oxides of nitrogen in air have been described by Hamilton *et al.* (*1*), who reported that iodine at a concentration of 10 parts per 100 million inhibits or reduces the formation of ozone, and by Stephens *et al.* (*2*), who found that rates of formation of aldehydes and of peroxyacetyl nitrate were materially reduced by iodine at concentrations as low as 25 parts per 100 million. Some experiments in the laboratories of the Air Pollution Control District, County of Los Angeles, have shown that iodine in similar systems may act to accelerate some of the secondary processes, in particular the consumption of nitrogen dioxide and ozone.

These experiments were carried out in a glass chamber of volume more than 1000 cubic feet, illuminated by mercury lamps and fluorescent tubes. Conventional air monitoring instruments were used to record apparent concentrations of nitric oxide, nitrogen dioxide, oxidants, and ozone; concentrations of iodine were calculated from the amounts supplied, and appropriate correction parameters were determined to account for the effects of the iodine on the instruments (especially the oxidant recorder, which depends on the production of triiodide in a column of potassium iodide). With this system (I_2 at concentrations of 25 or 100 parts per 100 million; ozone, olefins, and oxides of nitrogen at slightly higher concentrations) certain facts were demonstrated:

1) In the dark, iodine and ozone react at a moderately rapid rate, strongly dependent on the iodine concentration.

2) In the dark, the rate of reaction between nitrogen dioxide and ozone is substantially increased by the addition of iodine.

3) In the dark, the rate of reaction between olefin (isobutene) and ozone is substantially increased by the addition of iodine.

4) In an irradiated system containing nitric oxide and olefin, the rate of photochemical oxidation of nitric oxide is substantially reduced by the addition of iodine.

5) In the same system, the maximum concentration of nitrogen dioxide reached is essentially unaffected by the addition of iodine.

6) In the same system, the rate of consumption of nitrogen dioxide after the maximum is reached is substantially greater in the presence of iodine.

7) In the same system, the consumption of nitrogen dioxide leads to no accumulation of ozone.

It appears difficult to ascribe these effects of iodine solely to its possible reaction with oxygen atoms produced by the photolysis of nitrogen dioxide. In the system reported by Stephens, 25 parts of I_2 per 100 million (with 5 parts per million each of nitrogen dioxide and *cis*-2-butene) was sufficient to reduce the rate of aldehyde formation to about half the control value. This would imply that at least half the oxygen atoms react with I_2 instead of molecular oxygen, and our calculations suggest that this would require a collision yield of between 3 and 10 for the iodine-oxygen atom reaction.

Perhaps it is more likely that iodine molecules or atoms act specifically to inhibit chain processes in the photochemical system more effectively than do the oxides of nitrogen. Although Stephens *et al.* express doubt that long chains could develop in the presence of oxides of nitrogen, an example of data from the work of Tuesday (*3*) shows that postulation of a long chain is practically unavoidable in some photo-oxidation systems where nitric oxide is the initial reagent, without added nitrogen dioxide. In one case cited by Tuesday, the concentration of nitrogen dioxide was seen to rise from about 2 to 40 parts per 100 million in 2.0 minutes, under irradiation sufficient to decompose nitrogen dioxide in a nitrogen atmosphere at a rate of 0.55 min^{-1}. If the increase in concentration is assumed to be exponential, the rate of increase is 1.5 min^{-1}. This is nearly 3 times the specified nitrogen dioxide decomposition rate and therefore nearly 6 times the rate of primary photolysis, which is also the rate of oxygen atom production. Adding the rate of production of nitric oxide by the primary photolysis

leads to a calculated quantum yield of 6.4 for oxidation of nitric oxide.

In the same experiment, *trans*-2-butene (10 parts per million) was present; this should have reacted with oxygen atoms about 1/25 as fast as the molecular oxygen in the system. If the reaction chains were in fact started by this reaction, the minimum chain yield for oxidation of nitric oxide can be calculated as about 160; if only a fraction of the reactions between butene and oxygen atoms are effective in chain initiation, the chain yield would be even higher. If the chains develop only after those collisions which yield free radicals, the data of Cvetanovic (*4*) suggest that the appropriate factor may be from 3 to 10, giving an estimated chain yield of from 500 to 1600 in the example at hand.

Various investigators have expressed doubt that chains of this order of magnitude can be expected to occur in mixtures containing the odd-molecule oxides of nitrogen, because of the probability that most free radicals would react readily with these oxides. The difficulty is not particularly serious in the case of nitric oxide, inasmuch as the normal products of its reactions with alkoxy or acyloxy radicals would be nitrites, which are readily photolyzed to regenerate the radicals. This is not true of the nitrates, which are produced by reaction of nitrogen dioxide with alkoxy or acyloxy radicals, so there may still exist a legitimate question as to whether chain reactions, particularly long chains, are involved in photo-oxidation when the initial reagent is nitrogen dioxide. Another possibility which may be invoked to account for relatively large chain yields is that chain-branching may occur; thus, a reaction chain of six cycles with a branching factor of 3 would result in a chain yield of 729.

It seems likely that the further study of photo-oxidation systems with added iodine can contribute importantly to unraveling the mechanism of the photochemical smog reaction.

LOWELL G. WAYNE

Allan Hancock Foundation,
University of Southern California,
Los Angeles

References

1. W. F. Hamilton, M. Levine, E. Simon, "Atmospheric iodine for smog abatement," paper presented before the Division of Water and Waste Chemistry, American Chemical Society, Atlantic City, N.J. (Sept. 1962).
2. E. R. Stephens, R. H. Linnell, L. Reckner, *Science* **138**, 831 (1962).
3. C. S. Tuesday, in *Chemical Reactions in the Lower and Upper Atmosphere* (Interscience, New York, 1961).
4. R. J. Cvetanovic, *Can. J. Chem.* **36**, 623 (1958).

New Products

Strip-chart recorder (model VOM-5) accepts resistance, current, or d-c voltage input without the use of external converters. Six resistance ranges measure from 1 to 10^5 ohms full scale. Five full-scale current ranges cover 0.01 to 100 ma. Voltage is measured from 0.01 to 500 volts in six ranges. A Zener diode provides voltage reference. An event marker pen, used together with the recording pen, permits the user to mark the chart for later reference or to record such information as opening and closing of relays, pilot-light action, and other mechanical functions. Five chart speeds are provided. Intermediate chart settings disengage the mechanism permitting free movement of the paper. The instrument weighs 16 lb and measures 14½ by 4¾ by 11¾ inches. It can be operated in any of three positions: flat on the table, at a 30-deg tilt, or mounted vertically on the wall.—J.S. (Bausch and Lomb Inc., Rochester 2, N.Y.)

Circle 1 on Readers' Service card

Non contacting vibration gage (model 44 PAF-1) operates as a motion comparator to overcome the limitation of capacitance-type sensors that the amplitude of the output signal changes when the distance separating the pickup and the measured object changes. The instrument employs a self-calibrating technique in which the sensing element is itself vibrated at a frequency outside the band of measurement vibration frequencies of interest, and at known amplitude. An electronic circuit compares the calibrating signal thus produced with the signal due to the vibration being measured. Light signals on the instrument panel indicate when the gage is too close or too remote from the object. The range extends from 0.1 to more than 1.0 inch. Frequency and amplitude of vibration are indicated in the range 10 to 100 cy/sec and 0.3 to 30 mil. A pistol grip, provided for hand-held operation, is removable for static mounting.—J.S. (Raydata Corp., 1078 E. Granville Rd., Columbus 24, Ohio)

Circle 2 on Readers' Service card

Falling ball viscosimeter is 10 inches long with a diameter of 1 inch and requires only 5 ml of the test liquid. This viscosimeter is supplied with a glass ball and a stainless steel ball to extend the range. The size 1 balls allow viscosity readings from 0.25 to 15 centipoise; size 2, from 5 to 300 centipoise. To take a reading the instrument is filled with the test liquid and the ball is secured by the Teflon release. For most accurate work, the viscosimeter should be immersed in a constant-temperature bath with a transparent window for observation. The ball is released by turning a knob and the reading is taken by measuring the time of descent of the ball between the two sets of fiduciary lines. With good techniques, measurements should be reproducible to within 0.2 to 1.0 percent, depending on the time of descent. The viscosity u is now calculated by the formula $u = K(p_f - p)t$, where p_f is the density of the ball, p is the density of the liquid, and K is the viscosimeter constant found by measuring the time of descent of a standard liquid. The tube is made of precision-bore glass, the ball release of Teflon with Viton "O" ring, and the remaining plastic parts of polypropylene.—R.L.B. (Roger Gilmont, Inc., 1 Great Neck Rd., Great Neck, N.Y.)

Circle 3 on Readers' Service card

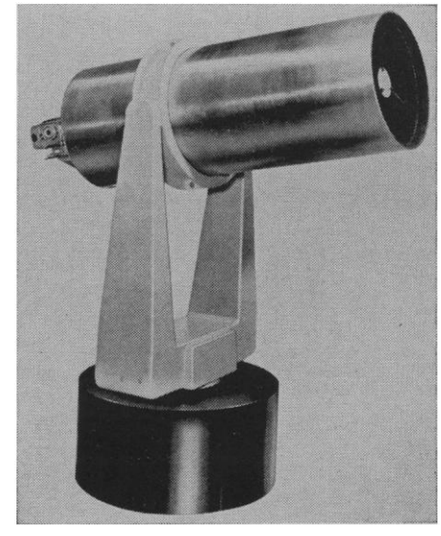
Space simulator of 75-ft³ volume is said to duplicate conditions that exist more than 1000 miles above the surface of the earth. Pressure is said to be in the low 10^{-11} mm-Hg range. The chamber is fabricated of stainless steel with internal dimensions 4 feet in diameter and 6 feet long. Both ends of the chamber have full-opening doors. Seals are effected with refrigerated "O" rings. Two 7½-inch windows provide access for solar simulation. The pumping system utilizes a diffusion pump of 4200 lit./sec capacity with a refrigerated cold cap and plate to provide baffling. Liquid-nitrogen consumption is less than 4 lit. per 8 hours. Control and measurement equipment is contained in a separate free-standing console.—J.S. (Ilikon Corp., Natick Industrial Center, Natick, Mass.)

Circle 4 on Readers' Service card

Ultramicro balance with knife-edge beam has readability to 0.1 μg by means of an optical scale. The precision is due largely to the careful alignment of the sapphire knife-edge bearings and to the triple-walled balance housing which eliminates errors due to temperature change. Capacity is 2 mg, optical taring range is 1 mg, sensitivity is 0.1 mg, and accuracy of differential weighing is ± 0.2 mg.—R.L.B. (Mettler Instrument Corp., 20 Nassau St., Princeton, N.J.)

Circle 5 on Readers' Service card

Lightweight all-metal **Cassegrainian telescope** is fabricated entirely of aluminum. Both its primary and its secondary mirrors are of lightweight cast-honeycomb design. The telescope tube is thermally insulated. Baffling prevents stray light from falling directly upon the image area. A mounting bracket

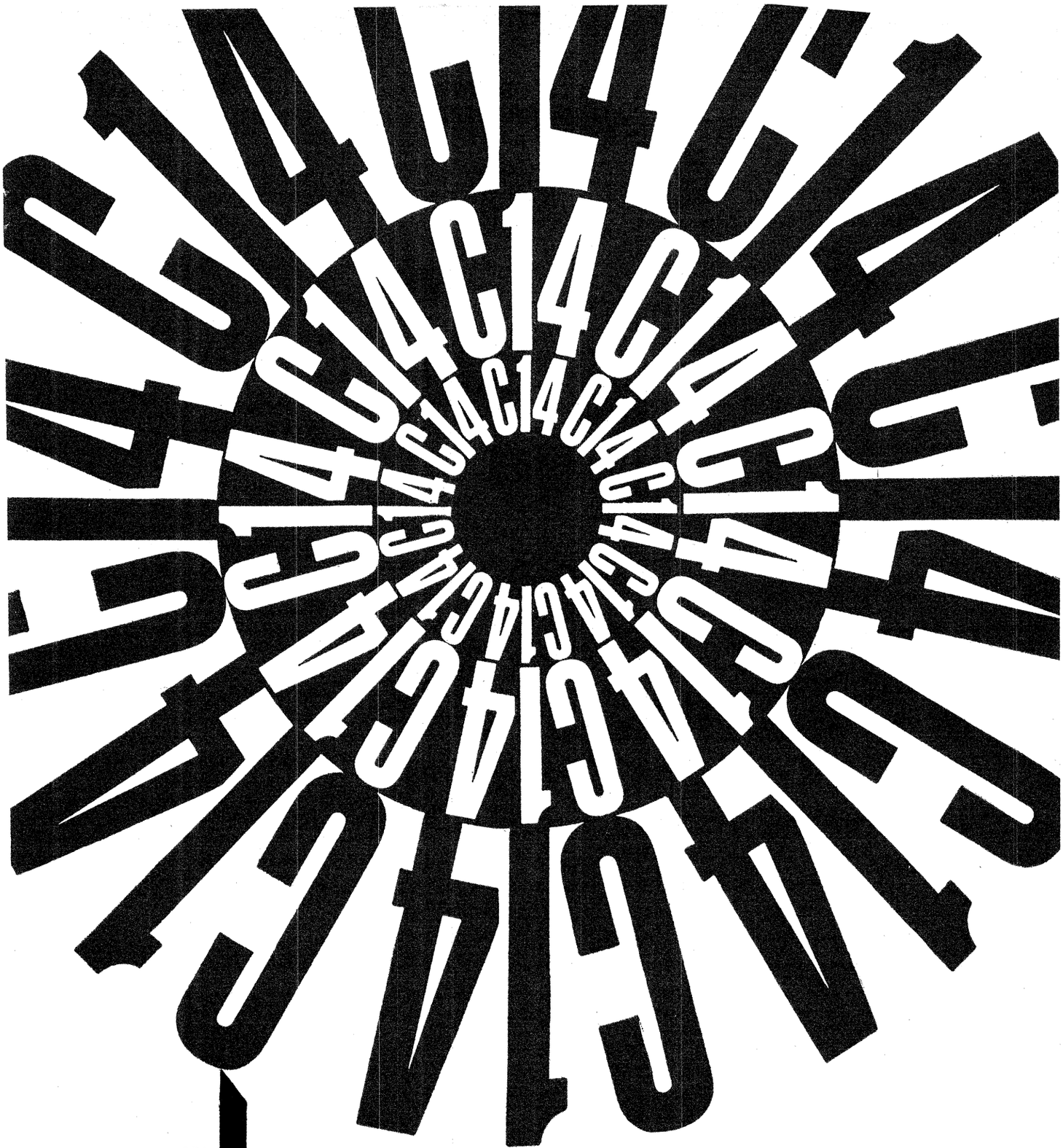


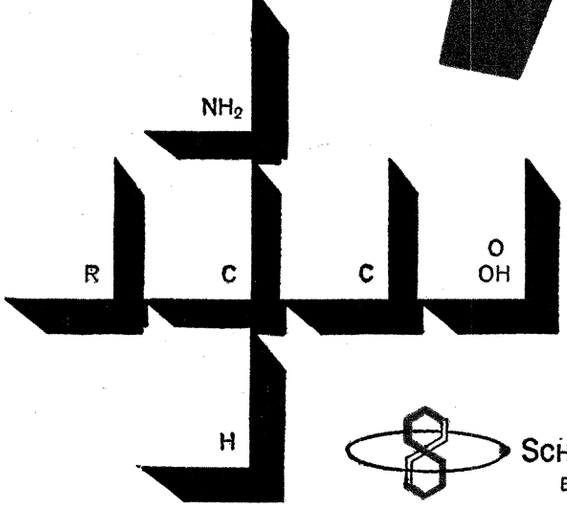
The material in this section is prepared by the following contributing writers:

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

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

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither *Science* nor the writers assume responsibility for the accuracy of the information. A Readers' Service card for use in mailing inquiries concerning the items listed is included on page 271. Circle the department number of the items in which you are interested on this card.





1000μc./mg. C^{14}-labeled L-amino acids
radiochemical purity greater than 99.5%
new low cost: $750/mc. $375/500$\mu$c. $75/100$\mu$c. $37.50/50$\mu$c.

SCHWARZ BIORESEARCH, INC. Mountain View Avenue, Orangeburg, N.Y.
BIOCHEMICALS • RADIOCHEMICALS • PHARMACEUTICALS for research, for medicine, for industry

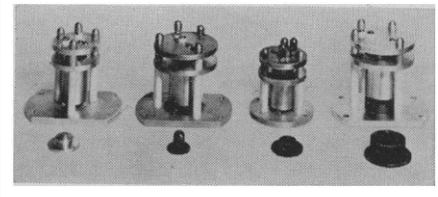
for cameras is adjustable for focusing down to 1000 feet. Nominal focal length is 240 inches. Aperture is *f*/16. Resolution is aperture-limited at 100 lines per millimeter. Weight is less than 50 lb. Overall length is 51⅝ inches and diameter is 16 inches. Other focal lengths, to 1000 inches, are available.—J.S. (Itek Corp., Lexington 73, Mass.)

Circle 6 on Readers' Service card

Flash generator (model SC-4) furnishes a parallel or slightly converging beam of light directed horizontally by a parabolic mirror. Frequency of flashing is adjustable between 1 and 20 per second. Flash duration is approximately 0.1 μsec. Special circuits can be supplied to produce either longer and more intense flashes, or shorter flashes, down to 1.5 nsec duration, but of less intensity. Flashes are produced by discharge of a capacitor into a tube filled with a mixture of krypton and traces of hydrogen. The spectrum of the emitted light beam consists of a continuous background upon which are superimposed the somewhat broadened lines of krypton and hydrogen. Electromagnetic disturbances arising from the discharge tube are said to have been reduced to a negligible minimum.—J.S. (Epic Inc., 150 Nassau St., New York 38)

Circle 7 on Readers' Service card

A series of four interchangeable **electron-beam guns** is designed to meet the needs of a range of materials processing applications, including welding, etching, microcomponent assembly evaporation, and melting. The gun units are triode types with emission level controlled independently of thermal inertia or filament characteristics



by grid-bias voltage. Temperatures greater than 7000°F are said to be attainable with efficiencies greater than 90 percent. The four guns currently in production are: type 3101, a 60-watt ultrahigh-resolution etching gun; type 3102, a 300-watt high-resolution welding gun; type 3103, a 10-kv normal resolution evaporation gun; and a 20,000-watt melting gun.—J.S. (Electron Heating Corp., Hicks Ave., Medford 55, Mass.)

Circle 8 on Readers' Service card

Tubular sheathed **superconductive wire** is said to have more than twice the field strength of zirconium-columbium wire and to be useful at temperatures as high as 18.5°K. The composite wire is available in both single and multiple sheath form. The multiple sheath material has the advantage that the outer sheath, which acts as electrical insulation, provides better thermal conductivity than nonmetallic insulation. The single sheath wire is made by drawing unalloyed columbium tubing over columbium-tin powder mixtures; multiple sheath wire is made by drawing an outer tube of Monel metal and an inner tube of columbium over the same mixture. After being formed, the wire is fired so that the core forms the intermetallic compound Cb_3Sn. The wire can be produced in diameters as small as 0.01 inch and in lengths up to 10,000 feet.—J.S. (Superior Tube Co., Germantown Ave., Norristown, Pa.)

Circle 9 on Readers' Service card

Temperature-gradient device provides the laboratory with a constant, controlled temperature gradient. The "Poly-Temp" also furnishes controlled shaking while simultaneously maintaining predetermined, multiple temperatures. Range is from +15° to +125°C with gradients between samples as little as 0.05°C. It permits studies and measurements to be made at closely controlled temperature increments to discover anomalous effects which, otherwise, may go unnoticed. It is claimed that up to 19 stable, precise temperature increments can be provided simultaneously to help study the temperature effects on chemical and biological systems. It eliminates the need for a series of expensive water baths or incubators, each set to a different temperature. The "Poly-Temp" can be used to study most temperature-dependent reactions including thermotolerance, growth, nutrient requirements, genetics, and so forth. Chemistry uses include determinations of solubility, adsorption isotherms, electrical conductivity, and the rates of many chemical exchange reactions. The "Poly-Temp" uses a solid aluminum block with controlled heating at one end and cooling at the other end. Each control has a separate pilot light to indicate operation. Temperature at each end is controlled by a thermistor controller to better than ±0.01°C. The top surface of the block is bored to accept up to 38 standard test tubes, ¾ inch outside diameter. The shaking mechanism provides variable controlled rota-

tion of the test tubes as they remain in constant contact with the block. Holes, to accept five thermometers, are equally spaced down the center of the block. The water-tight housing is stainless steel construction and rests on four Neoprene feet.—R.L.B. (Lab-Line Instruments, Inc., 3070 W. Grand Ave., Chicago 22, Ill.)

Circle 10 on Readers' Service card

Alpha and beta contamination monitors count both alpha and beta particles simultaneously. These instruments are made by E. M. I. Electronics, Ltd. of England. The CM-254 contamination monitor is portable, weighing 11 lb and measuring 8½ by 11½ by 8 inches. By using dual phosphor techniques with special transistor discriminator-trigger and gating circuits, it measures alpha and beta particles simultaneously. Separate audio tones distinguish between alpha and beta particles on a loudspeaker or earphones. A dual phosphor probe uses a 50-cm² dual ZnS(Ag) and plastic phosphor as monitors. Radiation passes through a light-tight screen and strikes the zinc sulphide surface first which stops the alphas and produces scintillations. Betas pass through the zinc sulphide with negligible loss and are dissipated in the thicker layer of plastic phosphor. All scintillations are picked up by a phototube which differentiates between them and feeds the pulses into a ratemeter circuit. Normal display is on a 3-inch panel meter with a log scale calibrated in counts per second. When monitoring alpha contamination giving a count rate less than 6 count/sec it is possible to switch the count into an electromechanical register to get an accurate count over as long a period as is required. This monitor has a range of 5000 count/sec and a resolution of 100 μ/sec. It is powered by flashlight batteries, but an a-c operated model is available also. The model HM-307 is a single hand monitor which monitors both sides of the hand for alpha and beta particles simultaneously. Its maximum permissible levels are adjustable over a wide range and two separate meters read alpha and beta counts. An alarm bell rings when the maximum permissible level is exceeded. —R.L.B. (Atomic Accessories, Inc., 811 West Merrick Rd., Valley Stream, N.Y.)

Circle 11 on Readers' Service card

Miniature **cryogenic refrigerator** designed for cooling infrared detectors, parametic amplifiers, and other low-noise electronic equipment, has a base about 4 inches square, a height of 12 inches, and weighs 12 lb., without motor. The machine operates on the Stirling cycle and the design utilizes two pistons that move in a single cylinder. Helium gas is compressed at ambient temperature and the resulting heat is removed. After the gas expands to produce cooling, it returns to the compression chamber. A regenerator extracts heat from the gas passing from the high-temperature region to the low-temperature region. The heat is stored temporarily. On returning from the low temperature zone, the gas reabsorbs the heat stored in the regenerator. The refrigerator covers the temperature range from 290° to 30°K. Cold production is 1 watt at approximately 30°K. Power efficiency at 40°K is said to be greater than 1 percent.—J.S. (North American Philips Co., Inc., Mendon and Angell Rds., Ashton, R.I.)

Circle 12 on Readers' Service card

Radiant heat furnace (model LTF-100) provides controlled temperatures to 3000°F. It is constructed in two semicircular shell sections, hinged along one side to permit opening of the other side, each mounting up to 26 quartz infrared lamps. The furnace is portable and can be used with or without air

cooling, depending on temperature requirement. Mounted around the outside of each shell half is an air manifold that can be connected to an air supply to feed cooling air through plastic tubes. The air passes through adaptors and holders to the lamp end seals, keeping their temperature below the limits specified by the lamp manufacturers. At switch on, the lamps are said to reach maximum heat output in 0.6 sec. At switch off, heat output drops 80 percent in 2 sec. Shell length is 12 inches and shell outside diameter is 12 inches. Inside clearance diameter is 8 inches. Cooling air requirement is 26 ft^3/min for 52 lamps.—J.S. (Hi-Shear Corp., 2600 W. 247 St., Torrance, Calif.)

Circle 13 on Readers' Service card

Space environment test chamber, designed for testing at pressure of 5×10^{-9} mm-Hg, employs elastomer "O"-ring seals and a 10-inch diffusion pump with internal water-cooled optical baffle. The test chamber, fabricated of 304 stainless steel, is 48 inches long and has a diameter of 30 inches. For degassing, it is heated by a tunnel-type thermostatically regulated bakeout oven that can be rolled over the chamber on low-friction wheels running on tracks. The oven employs radiant heaters and is capable of operating up to 250°C. The exterior surface of the chamber is traced with stainless steel coils for quick cooling after bakeout. A full-opening removable door and four ports 6-inches in diameter allow access and viewing. For operation in the 10^{-10} mm-Hg range, an alternative version employing metal seals is available. Instrumentation includes a choice of two Pirani or thermocouple gages and a Bayard-Alpert ionization gage. Controls and indicators are panel mounted on a movable console.—J.S. (Vacuum Specialties, Inc., Somerville 43, Mass.)

Circle 14 on Readers' Service card

Pulse analysis system consists of a CN-1024 digital computer unit of 1024-channel capacity, a model 220B data output unit, and an RM 503 cathode-ray-tube display unit. By addition of the model 240 display control unit and a model 216A coincidence pair spectrometer unit, three-dimensional display can be achieved. The model 216A unit is capable of making two-dimensional analysis of nuclear events, simultaneously analyzing two sources of information relating to the same event. By using the model 240 display unit with

the model 216A, indication is obtained of the relative number of counts stored or being accumulated at selected address locations. This third dimensional information is displayed by intensity modulation. Contours at selected depths can be examined by blanking out less than a determined number of counts.—J.S. (Technical Measurement Corp., 441 Washington Ave., North Haven, Conn.)

Circle 15 on Readers' Service card

Heat flux system, for measurements in high-temperature gases such as are encountered in rocket engines, derives its capabilities from the ability of the tubular-element water-cooled sensor to withstand heat fluxes up to 12×10^6 BTU/hr-ft^2. The sensor is a glass tube with a platinum surface film that constitutes a resistance element. The tube measures 0.006 inch outside diameter by 0.08 inch long. An electronic circuit maintains the surface film resistance essentially constant, hence maintaining temperature of the surface constant, for power inputs to the element up to 20 watts. The instrument is basically a heat flux meter with the electrical output giving a direct reading of heat transfer, both average and fluctuating, between the constant-temperature sensor and its environment. In a constant property fluid, the system operates as a constant-temperature anemometer. An aspirating probe that maintains constant Mach number past the sensor, converts the instrument to a temperature-measuring device by removing the effect of environment velocity. Response time is said to be in the microsecond range.—J.S. (Thermo-Systems, Inc., 2418 E. Hennepin Ave., Minneapolis 13, Minn.)

Circle 16 on Readers' Service card

The type-S ink **rectilinear recorder** is a transistorized direct-writing recorder that makes use of positional feedback from the stylus tip to increase accuracy. The standard instrument provides eight channels; up to 24 channels are available on special order. Frequency response is d-c to 150 cy/sec. Phase error from d-c to 100 cy/sec is said to be less than 0.1 msec delay and less than 0.7 msec at 150 cy/sec. Response time is 2.5 msec for a 5-mm deflection and 4 msec for a 10-msec deflection. Noise is less than 0.5 μv with preamplifier and is invisible without the preamplifier. Input with preamplifier is differential and input impedance totals 2 megohms. Without the preamplifier, input is single ended with input im-

pedance 1 megohm. Recording amplitude ranges from full channel width between d-c and 30 cy/sec, with progressive reduction to 5 mm at 150 cy/sec. Paper speeds between 0.1 and 25 cm/sec are selectable through electrical push-button controls. Higher speeds are optionally available. A coated paper is used for recording and is available in roll or folded form. Operating ambient temperature range is −20° to +50°C. Maximum power consumption with eight channels operating is 140 watts.—J.S. (Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif.)

Circle 17 on Readers' Service card

Fraction collector, the Filamatic, collects the column effluent by means of a precision balance. When the desired weight of effluent has been received from the column, the liquid is discharged into the collecting tube. The tube rack then indexes automatically to position the next test tube under the discharge opening and the cycle of operation is repeated. The Filamatic utilizes 20 individual plastic test tube racks, each containing ten 18-mm test tubes to provide a total of 200 tubes. Other size test tubes may be used, by replacing the racks. A rack of ten test tubes may be removed at any time during operation. Volumes measured with the Filamatic are more precise than those obtained with conventional time, drop-count, or siphon methods. Five push-button controls simplify operation. All exposed parts are fabricated of a chemical-resistant plastic or stainless steel. The test tube racks may be removed by simply lifting them from the machine. The collector requires only 12 × 27 inches of bench space.—R.L.B. (National Instrument Co., 4119 Fordleigh Rd., Baltimore 15, Md.)

Circle 18 on Readers' Service card

Pressure-volume regulator is designed to attain and adjust calibration pressure in trapped, nonflow, pneumatic systems. With the regulator installed in a calibration system, pressure is introduced from a pressure source into the test system. Exact adjustment of pressure is then made by manipulating coarse and fine adjustments. The regulator can be used as a pressure generator from −10 to +15 lb/in.^{2}-gage when test system volume is approximately 10 in.^{3} or less. Operating pressure range is 0 to 500lb/in.^{2} and generated pressure is 0 to 15 lb/in.^{2} Adjustment sensitivity is 0.001 percent of maximum regulator

volume (50 in.^{3}). Maximum leak rate at any piston position with balance valve open is less than 10^{-5} atm cc/sec of helium.—J.S. (Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.)

Circle 19 on Readers' Service card

Air motor peristaltic pump (model T33050-1) is run by an explosion-proof air motor and thus requires no electricity. This is a "twin" to Greiner's electrically operated peristaltic pump. With variable feed capability it is for the continuous transfer of liquids and gases and may be used where electrical operation is undesirable. Delivery rate may be adjusted from 4.7 lit./min to just a few drops per minute. The problems of cleaning and contamination are eliminated, as changeover from one fluid to another is made by changing the tubing. The air input to the motor is controlled by means of a needle valve.—R.L.B. (Greiner Scientific Corp., 22 North Moore St., New York 13)

Circle 20 on Readers' Service card

Multiple-spindle magnetic stirrer provides laboratories with constant-speed magnetic stirring as required in tissue culture applications, fermentation studies, and general purpose stirring. Up to 12 positions for magnetic stirring can be obtained with variable speeds of 150 to 900 rev/min. The basic power unit is a four-position multiple-spindle stirrer with a vertical support rod at each position. To this basic unit can be added slave units and water baths multiplying the number of situations in which this equipment can be used. The power unit has variable speeds from 150 to 900 rev/min. Constant speed is maintained at a given speed setting despite load and line voltage fluctuations. Large Alnico magnets produce ample rotating magnetic field at each position, even for large stirring jobs. The size of the field minimizes the necessity for exact location of spinner flasks. Under some conditions more than one spinner flask can be operated at one stirring position. Heat produced by the power unit is dissipated at the rear of the unit by a fan, so that the temperature of the stirring platform is not affected. Four-position, multiple-spindle, magnetic stirrer slave units, complete with four vertical rods, are available separately and can be added as required in a "building block" concept. The basic power unit is capable of driving two slave units, making

possible a total capacity of 12 stirring positions. Containers can be removed and replaced at will throughout any of the 12 positions with no change of speed, giving maximum utilization of all 12 positions. The slave units can be connected in a line (end to end) or parallel (front to back) by a belt drive. Water baths are available which can be placed directly on the stirring platforms of both the power and slave units. Both plastic and stainless-steel water baths can be provided. With the plastic water bath, constant temperature can be controlled to $\pm 0.5°C$ within a temperature range from ambient to 42°C. With the stainless-steel water bath, constant temperature can be controlled to $\pm 0.5°C$ within a temperature range of ambient to 80°C. The magnetic stirring concept is used to circulate water in the bath for constant temperature. Utility outlets on the power unit provide convenient supply for all water-bath heater units. The stirrer assembly is 76 by 16½ by 12½ inches high.—R.L.B. (Eberbach Corp., P.O. Box 1024, Ann Arbor, Mich.)

Circle 21 on Readers' Service card

The AFA-2 apparatus for determining **particulate material surface area** operates on the adsorption flow principle employing nitrogen. The material to be measured is degassed under vacuum in a sample bulb attached to the apparatus. The sample is then allowed to cool to room temperature, and a liquid-nitrogen bath is placed around the bulb. For single-point reading, a constant rate of nitrogen gas, previously calibrated, is introduced into the bulb and is adsorbed by the sample until a preselected equilibrium adsorption pressure is attained. The surface area is calculated from the rate and time of gas flow and the total free space volume of the system. For multiple-point readings, known volumes of gas from a calibrated-gage section of the apparatus are successively expanded into the sample section.—J.S. (Numec Instruments & Controls Inc. Apollo, Pa.)

Circle 22 on Readers' Service card

Oil bath temperature controller and stirrer heats and stirs the oil or water medium, regulates its temperature, and, if desired, circulates the liquid to an external apparatus such as a viscosimeter. Temperature range is from −30° to +150°C and the control in this range is accurate to $\pm 0.05°C$. Temperatures below ambient require refrigeration.

The Booster Tempunit has, in addition to its 1000-watt controlled heater, a booster heater of 1000 watts to accelerate the initial heating and thin the oil. This unit is equipped with a centrifugal pump capable of circulating up to 10 lit. of oil or water per minute to an external apparatus. Pneumatic control, rather than electronic control, is used to allow sensitivity but avoid the need for fragile glass sensing devices. This control is accomplished by using a neoprene bellows. A fiber-cushioned clamp, cast as part of the housing, enables the unit to be attached to almost any kind of container. The unit measures 12 inches long, weighs 9 lb, and operates on standard house power.—R.L.B. (LaPine Scientific Co., 6001 S. Knox Ave., Chicago 29, Ill.)

Circle 23 on Readers' Service card

Frequency counter/computer (model 5510) measures the frequency of the input signal by measuring the period of an integral number of cycles and converting this period to frequency by means of an internal computing device. For example, to measure 60 cy/sec, the instrument will measure the time for 48 cycles of the 60 cy/sec input. The computer will then divide 48 into the time, which might be 0.8005 sec, and display the result as 59.9997 cy/sec. The complete measurement is performed in 1 sec with estimated error ±0.005 percent. Display time is adjustable from 0.2 to 5 sec or the display may be set to remain until a reset button is depressed. Measurement frequency range

is 0.02 to 100,000 cy/sec. Measuring time is 10 sec below 10 cy/sec and 1 sec above 10 cy/sec. Nominal input sensitivity is 1 volt at 10,000 ohms. Maximum standard input ranges are 1, 3, 10, 30, and 100 volts. Sensitivity down to 0.1 volt at impedance of 100,000 ohms can be provided.—J.S. (Wang Laboratories, Inc., 12 Huron Dr., Natick, Mass.)

Circle 24 on Readers' Service card

Pore-size and surface-area apparatus utilizes a continuous flow of nitrogen-helium mixture of fixed composition over the sample to determine adsorption isotherms from stepwise variations of the total gas pressure on the sanple. By means of this data, a pore-size distribution of the radius range from 10 to 300 Å is calculated. Isotherms can be developed with the device in from 6 to 8 hours, said to be roughly one-fifth the time formerly required with conventional methods for determining low-temperature nitrogen adsorption.—J.S. (Engelhard Industries, Inc., 113 Astor St., Newark 14, N.J.)

Circle 25 on Readers' Service card

Electrometer system is a dynamic capacitor electrometer designed for measuring minute electrical currents or charges originating in a high-impedance source. In addition to analytical determinations, this device can be used in critical measurement of electrical properties such as charge effects, high resistances, and piezoelectric phenomena. The model 6010 Dynacon is capable of measuring currents as low as 5×10^{-17} amp and charges in the region of 5×10^{-16} coul, with ± 1-percent overall precision for currents of 10^{-15} amp, and a response speed of 0.25 sec. Measurement can be made by the equilibrium-voltage or rate-of-change method, or the instrument can be used as a null indicator for maximum accuracy. Outputs are furnished for both 10-mv potentiometric and 1-ma galvanometric graphic recorders.—R.L.B. (Nuclear-Chicago Corp., 359 Howard Ave., Des Plaines, Ill.)

Circle 26 on Readers' Service card

The series 450 **signal tracking filter** is adjustable in band-pass from 2.5 to 100 cy/sec and is entirely solid state in design. The center frequency is electronically servoed by phase-lock techniques to the frequency of the input signal. The input signal frequency can vary over a range of 100 cy/sec to 120 kcy/sec while being automatically

tracked through a signal-to-noise ratio range up to −38 db. Should the input signal be completely lost in the noise, the filter will automatically search about the last known frequency to reacquire it. An optional feature permits a pilot signal to be fed into the filter from an external source, whereupon the filter will lock on and continue to track the input signal when it reaches the pilot frequency. Other optional features include a wide-band detector to extract amplitude-modulated or phase-modulated intelligence from the tracked signal.—J.S. (Interstate Electronics Corp., 707 East Vermont Ave., Anaheim, Calif.)

Circle 27 on Readers' Service card

Portable **a-c/d-c volt-ammeter standard** (model 1572) is said to provide accuracy of ± 0.05 percent and features digital readout. No multiplying factors are required with the digital readout; a movable, lighted decimal point is provided. The accuracy cited applies to d-c voltage measurements from 0.01 to 1500 volts and to d-c current measurements from 100 μa to 1.5 amp. The 0 to 0.150 and 0 to 1.500 voltage ranges are potentiometric; all other d-c voltage ranges have input impedance of 750 ohm/volt. Reading accuracy of ± 0.05 percent of indicated value is provided for a-c measurements of voltage from 1 to 1200 volts, and accuracy of ± 0.1 percent of indicated value for a-c current measurements from 0.01 to 12 amp. Input impedance for a-c voltage ranges is 100 ohm/volt and frequency range is 50 to 2500 cy/sec. Temperature range for accuracies cited is 20° to 30°C.—J.S. (Weston Instruments Div., Daystrom, Inc., 614 Frelinghuysen Ave., Newark 14, N.J.)

Circle 28 on Readers' Service card

The **Kerr cell pulser** (model KCP-101) is designed to drive Kerr cells to be used as switching elements in lasers. The instrument combines a high-voltage supply for the output circuitry, continuously adjustable between 4 and 10 kv; a low-voltage supply for the pulse trigger circuitry; two parallel pulse circuits, each tailored to a different time base; and an internal repetitive trigger with provision for external triggering. Three modes of operation are selectable by switch: a repetitive mode with pulse width in the microsecond range; a repetitive mode with pulse width in the millisecond range; and an on-off switching mode. Rise times in all modes are

20 nsec or better and output repetition rate is up to 100 per second. The unit is capable of driving a load of 50 pf or less and the output is fed to the load via coaxial cable.—J.S. (Advanced Kinetics Inc., 1231 Victoria St., Costa Mesa, Calif.)

Circle 29 on Readers' Service card

Solid-state **electrooptic light modulators** are available in three models. The modulators, analogs of the Kerr cell, operate by the Pockels effect. They consist of flat, optically polished plates of ammonium dihydrogen phosphate, potassium dihydrogen phosphate, or potassium dideuterium phosphate, with faces perpendicular to the z-axis. The crystal is placed between two transparent electrodes that allow light to pass in the same direction as the applied electric field. The three models, available in any of the materials mentioned, use three different types of electrodes. The model 101 employs a transparent conductive coating; the model 201, a conducting glass; and the model 301, a conducting metallic grid. Dimensions of the modulators are 1¾ inches in diameter by 15/16 inch long.—J.S. (Isomet Corp., 433 Commercial Ave., Palisades Park, N.J.)

Circle 30 on Readers' Service card

The models LB-300 and LB-100 **load banks** provide a set of resistive dummy loads adjustable by pushbutton in 1-amp steps from 0 to 300 amp at 28 volts d-c and from 0 to 100 amp in the two models, respectively. Finer control, down to 0.2 amp, is obtainable from a vernier potentiometer, with direct-reading ammeter and voltmeter provided for continuous monitoring. Terminals for the addition of external instrumentation and forced air cooling of the load resistors are also provided. The instrument measures 38 by 26 by 33 inches.—J.S. (Associated Testing Laboratories, Inc., 200 Route 46, Wayne, N.J.)

Circle 31 on Readers' Service card

Pressure calibration system (model 802) has a range of 0.1 to 200 lb and is said to offer stability better than 0.002 lb/in.^{2} and resolution of 0.00005 lb/in.^{2} The system consists of a reference pressure cell and a reference pressure indicator. The pressure cell consists of a reference pressure chamber for storage of a precise amount of gas, a thin metal diaphragm, a fixed capacitor plate, and a capacitor-diode bridge circuit. As the system pressure above the diaphragm varies, the diaphragm moves with respect to the fixed capacitor plate. The resulting change of capacitance is detected by the reference pressure indicator. The indicator circuit consists of an oscillator operating at approximately 150 kcy/sec, and a bifilar transformer feeding a capacitor-diode bridge circuit. The d-c unbalance is fed to a null indicator on the panel of the indicator. Since the instrument uses a trapped volume of gas, the pressure is directly proportional to the absolute temperature. The unit must therefore be operated in a constant temperature enclosure. An ice bath is recommended by the manufacturer for this purpose. The pressure indicator is designed to handle five reference pressure cells.—J.S. (Rosemount Engineering Co., 4900 W. 78 St., Minneapolis 24, Minn.)

Circle 32 on Readers' Service card

Electrically compensated **thermocouple reference junctions** are designed to replace ice baths and hot reference junctions, and to operate under peak vibration and shock environments of 100 grav and greater. Standard air-

borne units feature a 32°F reference temperature and are said to provide tracking accuracies of ± 2°F for Chromel-Alumel and ± 1⅓°F for Chromel-constantan over the ambient range 20° to 180°F. Rack-mounting units are said to be accurate within ± 0.25°F over normal room ambient variations. Optional features include standardized full-scale output ranges, built-in calibration circuit choice of reference temperature between −450° and + 500°F. Single and multiple-channel versions are available.—J.S. (Electrowest Inc., 2351 Albatross Way, Sacramento 15, Calif.)

Circle 33 on Readers' Service card

The type 1025-A standard **sweep-frequency generator** covers frequencies from 700 kcy to 230 Mcy/sec in ten ranges with bandspread ranges for 400 to 500 kcy/sec and 10.4 to 11 Mcy/sec. Other ranges may be substituted in place of one or more of the standard ranges. The selected frequency range is swept from low- to high-frequency end in 22.2 msec, 20 times per second. The output is blanked during the return sweep. A synchronized saw-tooth sweep voltage for display-oscilloscope deflection is adjustable up to 100 volts peak-to-peak, and the starting point of the display sweep is also adjustable. An adjustable marker provides frequency and amplitude calibration. The radio frequency output is adjustable from 0.3 μv to 1.0 volt. Output is held to preset level within 0.1 db to 100 Mcy/sec and within 0.25 db to 230 Mcy/sec. Impedance is 50 ohms, resistive, and voltage-standing wave ratio is less than 1.01 to 1.00 at panel output connector.—J.S. (General Radio Co., West Concord, Mass.)

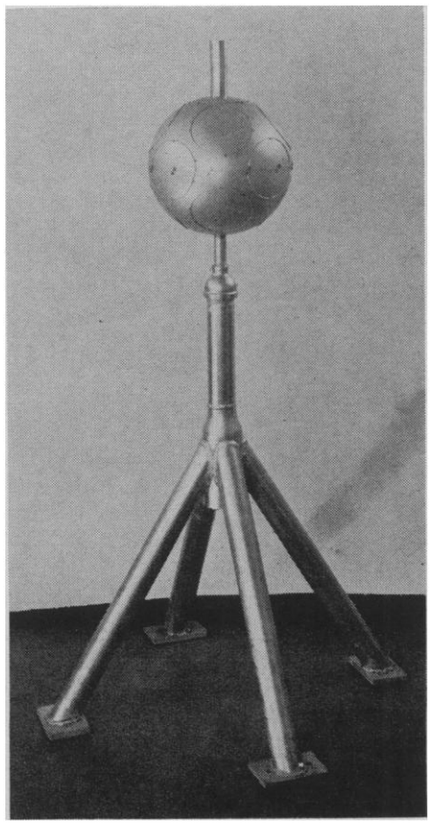
Circle 34 on Readers' Service card

Heat rate transducers are available in three models. The transducers are slug-type calorimeters that are designed for short-duration, heat transfer measurements. The sensing mass is a copper disk mounted in a Teflon bushing. A chromel-constantan thermocouple is mounted on the back side of the device to act as temperature sensor. The disk and bushing assembly is potted in a stainless-steel shell. Weight of the transducer is 0.5 g plus the weight of the output cable. Area of the sensing surface is 0.0019 ft². Accuracy and linearity are said to be ± 5 percent of full scale. Diameter is 0.250 inch and length 0.35 inch. Ranges and outputs for the three models are: model HT-10,

1 to 10 BTU/ft² sec, 2 to 20 mv/sec full scale; model HT-100, 10 to 100 BTU/ft² sec, 10 to 100 mv/sec; model HT-400, 100 to 400 BTU/ft² sec, 40 to 160 mv/sec full scale.—J.S. (Instrument and Engineering Co., P.O. Box 257, Tullahoma, Tenn.)

Circle 35 on Readers' Service card

Dynamic wind vector indicator gives a direct reading of all three components of the wind vector with an output for each axis that is linear with respect to force. Frequency response is said to be 10 cy/sec, with velocity and direction always in phase. The sensor is a sphere 1 ft in diameter, mounted on a rigid support by means of three internal



flexure members. Wind drag causes displacement of the sphere with respect to the support. Differential transformer slugs mounted on each flexure produce output signals proportional to each component of the force on the sphere. Output is a d-c voltage in the range 0 to 0.5 volt with output impedance 3000 ohms. All circuitry is transistorized. Operation is said to be unhampered by severe weather, dust, sand, or other difficult environments and prolonged periods of unattended measurement are possible.—J.S. (Flow Corp., 205 Sixth St., Cambridge 42, Mass.)

Circle 36 on Readers' Service card

(Continued from page 201)

mittee which would have provided grants of $2.5 billion over 5 years for grants to the states to use as they saw fit for construction or raising teacher pay in the public schools. The Roman Catholic hierarchy opposed a school-aid bill which did not include loans for private schools. Rep. John McCormack, then Majority Leader and now Speaker, took the same view. Two northern liberal members of the Rules Committee, Representatives O'Neil and Delaney, sided with Republican and Southern Democratic members of the committee in a series of actions which finally led to the tabling of bills for school aid, college aid, and the extension of the National Defense Education Act.

It would be unrealistic, however, to deduce that the Rules Committee has an independent, life-or-death sway over legislation. The power of the Rules Committee and its chairman to delay or derail legislation is greatest when controversial legislation is involved and a significant number of members are not anxious to stand up and be counted.

In the case of many types of education legislation, there is a solid bloc of opposition to federal aid composed mainly of Republicans from less industrialized states and Southern Democrats. For the proponents of federal aid—the Northern liberal Democrats and a few Republicans from urban areas—the church-state issue creates political problems which none of the current formulas on federal aid appear to resolve. When race, religion, or "welfare" is involved, the administration majority in the Rules Committee is likeliest to falter, just as is the administration majority in the House itself.

It must be remembered that a good many Congressmen cherish the Rules Committee as a guarantor of Congress's separate powers. Conservatives of both parties regard the operation of the committee as a permanent battle of Thermopylae against reckless legislation and ruinous spending. Many Republicans see it as a bulwark of minority rights.

Conservatives and liberals alike are conscious that the Rules Committee sometimes saves them the necessity of voting aye or nay on measures which they may regard as bad legislation, but

on which there may be heavy pressures from lobbyists or constituents. The knowledge that reform can cut more than one way may be one reason that proposals to effect basic changes in the Rules Committee's own rules of operation were not pressed during the fight last week on the size of the committee.

Chances for root and branch reform of Congress, however, seem better this year than for a long time. The intramural squabble between Senate and House appropriations committees last year and misgivings about the ability of Congress to deal with the problems of the Cold War and space age with its present machinery, staffing, and folkways have created a disposition to consider reform.

The likeliest route to reform is along the path followed by the LaFollette-Monroney Committee in 1946 when reform legislation followed a study by a committee made up of Senators and Representatives. Sen. Clark and Reps. Reuss and Lindsay have taken the initiative in rallying bipartisan support for such a committee and Sen. Case has put forward a similar, but somewhat more detailed, proposal.

The Legislative Reorganization Act of 1946 resulted primarily in a streamlining of committees but did not touch the bedrock of the committee system, and the reformers now face the same hard fact that the power of change in Congress is largely in the hands of those whose status depends on the status quo.—JOHN WALSH

Announcements

The National Institutes of Health this month opened a Tokyo branch of its Office of International Research. This will be the Pacific office. The unit is headed by Heinz Specht, formerly in the physical biology laboratory, National Institute of Arthritis and Metabolic Diseases.

Correspondence for the Pacific branch should be addressed to the American Embassy, APO 94, San Francisco, Calif.

The Thomas Alva Edison Foundation has presented its 1962 awards for children's books. The recipients included:

Heinz Haber's *Stars, Men, and Atoms* (Golden Press, 1962; 188 pp., illus., $3.99), acclaimed as the "best children's science book," covers early conceptions of the earth to modern theories of an expanding universe.

Knowledge and Wonder, by Victor Weisskopf (Doubleday, 1962; 222 pp., illus. $4.95), received the award of "best science book for youth," for its presentation of the "essence of all that man has discovered about himself and his environment."

The Edison Foundation awards are presented annually "for the highest achievements" in children's books, films, television, and radio.

Grants, Fellowships, and Awards

The Daniel and Florence Guggenheim Foundation has made available 14 graduate fellowships for study in **jet propulsion and flight structures development**. Candidates must be residents of the U.S. or Canada, and intend to make a career in astronautics, flight structures, or related scientific disciplines. Tuition and up to $2400 stipends are provided.

Participating in the program are Princeton University, California Institute of Technology (for jet propulsion fellowships), and Columbia University (for flight structures). Deadline for filing credentials: *1 March*. (Dean of Graduate Studies of each institution)

The University of Miami Marine Laboratory has a continuing fellowship program for postdoctoral work with **marine organisms**. The 1-year fellowships are available to those trained

in the other biological disciplines. Stipends are about $5,000, plus dependency allowances. (Charles E. Lane, Program Director, NIH Post-Doctoral Fellowships, University of Miami, Miami 49, Fla.)

Contract research proposals in **fundamental hydromechanics** of importance to the Navy are being solicited by the David Taylor Model Basin. Of particular interest are studies in fluid mechanics, naval architecture, and underwater acoustics. Deadline for receipt of proposals (in quadruplicate): *15 March*. (Commanding Officer and Director, David Taylor Model Basin, Washington 7, D.C. Attention: Code 513)

A limited number of travel grants to the 3rd international congress of **biometeorology** (Pau, France; 2–7 Sept. 1963) are available to defray partial expenses of American scientists. Deadline for application: *1 March*. (National Science Foundation, Washington 25, D.C.)

Representatives of the nation's dairy industry have established a research grant program to investigate the relationship of **dairy products and cardiovascular disease**. Emphasis will be on the metabolic behavior of dairy products or interactions between dairy product components with regard to lipid metabolism, development of atherosclerosis, or thrombus formation in suitable experimental animals or in man. Particularly encouraged are investigations which simultaneously provide guidance for the development of nutritionally superior dairy products. Studies concerning the nutritional value of milk fat or the factors modifying the proportions of the major or minor components of dairy foods influencing dairy fat utilization also may be considered. (Merrill S. Read, Special Dairy Industry Board, 111 N. Canal St., Chicago 6, Ill.)

Courses

The Virginia Institute of **Marine Science** is conducting a summer research program, sponsored by the National Science Foundation, to assist college teachers in conducting their own research projects. The Institute also has available a limited number of opportunities for undergraduate students, to allow them to explore the possibilities

of marine science as a vocation. The programs will be held 10 June to 30 August. Deadline for applications: *15 March*. (Robert S. Bailey, Director, NSF Programs, Virginia Institute of Marine Science, Gloucester Point, Va.)

A new course on special applications of gas **chromatography** in the biomedical field is scheduled for 20–23 March, in Stratford, Conn. Analytical Engineering Laboratories, Inc., Hamden, Conn., will sponsor the course. Subjects to be covered include gas chromatographic analysis of fatty acids, steroids, urinary steroids, and alkaloids. Advance registration is required. Deadline: *1 March*. (Philip D. Hercz, Analytical Engineering Laboratories, Inc., P.O. Box 5215, Hamden 18, Conn.)

The American Mathematical Society's 3rd summer seminar on **space mathematics** will be held from 1 July to 9 August in Ithaca, N.Y. The seminar, a joint undertaking with Yale University Observatory's summer institute in dynamical astronomy, will include 2 weeks of basic training in practical astronomy, the classical theory of elliptic orbits, methods of orbit determination, and mathematical techniques useful in such areas. Participants who have previous training in astronomy or mathematics may forego the basic courses. Tuition for participants from industry is $100 per week; persons from academic institutions and government agencies may apply for waiver of tuition. A limited amount of financial aid will be available from funds supplied by the society. Deadline: *15 February*. (J. Barkley Rosser, White Hall, Cornell University, Ithaca, N.Y.)

Massachusetts Institute of Technology is offering two short summer courses on **infrared spectroscopy**. Techniques of infrared spectroscopy, 17–21 June, will consist of 30 hours of lecture and laboratory work, designed to give both theoretical and practical knowledge of the fundamental optics of infrared spectometers. The course will include factors determining design, performance, qualitative and quantitative analysis, and techniques for sample preparation.

Applications of infrared spectroscopy, 24–28 June, will be devoted to lectures and supervised group practice on interpretation of spectra, group frequencies, and integration of intensities and applications to the solution

of chemical research problems. (J. M. Austin, Director, Summer Session, Room 7-103, M.I.T., Cambridge 39, Mass.)

Behavioral scientists are invited to apply for participation in a research training institute in the **simulation of cognitive processes**. The institute is scheduled for 17 June–26 July, in Santa Monica, Calif., and is sponsored by the Social Science Research Council and the RAND Corporation. It will cover recent developments in constructing computer programs that serve as models of complex human processes, as well as provide instruction in constructing techniques for such programs. The course is designed primarily for postdoctoral behavioral scientists who are affiliated with universities, although advanced doctoral candidates will also be considered. Deadline for completed applications: *15 March*. (B. F. Green Jr., Department of Psychology, Carnegie Institute of Technology, Pittsburgh 13, Pa.)

Specialized training programs in **steroid biochemistry** have been established at Clark University, Worcester, Mass., and the University of Utah, Salt Lake City; classes will begin 1 October. Sponsored by the National Cancer Institute, the programs include lectures, planned laboratory work, and research in theoretical and methodological aspects of the biochemistry of steroids and related compounds.

Postdoctoral work at both institutions will carry a $5500, 1-year stipend; predoctoral workers, at Clark only, will receive a 6-month stipend of $1800. Deadline for receipt of applications: *1 April*. (Kristen Eik-Nes, Department of Biochemistry, College of Medicine, University of Utah, Salt Lake City; or William R. Nes, Department of Chemistry, Clark University, Worcester, Mass.)

Publications

A new report shows that for more than 110,000 U.S. scientists the 1962 median salary was $10,000. This indicates a $1000 rise since 1960. These and other data on U.S. scientists are presented in **Scientific Manpower Bulletin No. 19**, a preliminary report released last month by the National Science Foundation, based on information compiled through July 1962. The 10-page publication also reports that the

youngest employed scientists were in the mathematics and physics fields (median age, 36), while the oldest were biological scientists (median age, 41). The most frequently reported work was research, development, or design, claimed by 35 percent of those reporting. Teaching claimed 17 percent of the scientists, and 15 percent were in the employ of the federal government. (Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 15¢. NSF 62–47)

Approximately 2300 references on chimpanzee research are contained in the new **Chimpanzee Bibliography**, published by the Aeromedical Research Laboratory at Holloman Air Force Base, New Mexico. The entries are divided into the major areas of anatomy, physiology, pathology, and psychobiology. English translations are made on all foreign language entries. (Frederick H. Rohles, Jr., Chief, Comparative Psychology Branch, 6571st Aeromedical Research Laboratory, Holloman Air Force Base, New Mexico)

The U.S. Atomic Energy Commission has published a bibliography of the world's literature on **radioactive fall-out**. The book includes more than 1500 references to unclassified reports, journal articles, and other literature on radioactive materials produced by nuclear explosions. The references cover the period from October 1960 to February 1962, and include subject, author, and availability indexes, as well as a list of the Commission's depository libraries. (TID-3086 (Suppl. 1), Office of Technical Services, Dept. of Commerce, Washington 25, D.C. $3)

A summary of scientific observations made from many Hungarian observatories has been published in atlas form. **Climatic Atlas of Hungary** (*Magyarorzag Eghajlati Atlasza*) is an album of 130 chromotypographic maps with index and explanatory texts in Hungarian and German, published by the Publishing House of the Academy of Sciences of Hungary. (Kultura, Hungarian Trading Company for Books and Newspapers, P.O. Box 149, Budapest, Hungary. $20.70)

Engineers and architects are advised about protecting structures from nuclear fallout in a new Office of Technical Services publication, **Radiological Protective Construction**. The report presents principles of protecting both per-

sonnel and facilities from radiation hazards, through utilization of such construction ideas as minimizing voids and projections, avoiding unnecessary horizontal surfaces, furnishing high velocity drainage, and designing more massive roofs, floors, walls, and partitions. (Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. $3. Order AD 275 990)

A new bibliography of current Russian technical publications is available from the Special Libraries Association. **Guide to Russian Reference and Language Aids: SLA Bibliography No. 4** contains more than 225 annotated entries, primarily regarding post-World War II material. Titles of the works are transliterated according to the Library of Congress system.

The 96-page guide has four appendixes with information on Russian transliteration systems, retail sources for Russian publications, abbreviations of Soviet publishers, and a glossary of bibliographic terminology. (Special Libraries Association, 31 East 10 St., New York 3. $4.25)

Scientists in the News

Henry Eyring, chemistry professor and dean of the graduate school at the University of Utah, has become president of the American Chemical Society. President-elect of the society is **Maurice H. Arveson**, research coordinator at Amoco Chemicals Corp., Chicago.

The highest decoration of the Bolivian government has been awarded to **Ismael Escobar**, director of the cosmic physics laboratory at the Universidad Mayor de San Andres, La Paz, Bolivia. The award, Officer of the Order of the Condor of the Andes, was presented "in recognition of his scientific work, and his operation of the laboratory," which is the world's highest (17,100 feet above sea level) permanent cosmic ray research station.

H. Rocke Robertson, chairman of the surgery department at McGill University, has become the school's principal.

Grady B. Hall, formerly with the Lockheed Missiles and Space Company, has become Lockheed Propulsion Company's director of reliability engineering.

W. Dean Warren, associate professor of surgery at the University of Virginia, has been appointed professor and chairman of the University of Miami's department of surgery in the school of medicine.

Bruce MacLean Eberhart, formerly of the department of biology, Princeton University, has been named head of the biology department at the Woman's College of the University of North Carolina, Greensboro.

Head of the Philco Corporation's newly formed Advanced Technology Laboratory, in Blue Bell, Pa., is **Peter M. Kelly**, formerly director of research in the company's electronic sciences department.

Donald G. Lee, anatomy professor and head of the laboratories of anatomy at the University of Pennsylvania School of Veterinary Medicine, has been appointed associate dean of the school.

Mahinder S. Uberoi, formerly professor of aeronautical and astronautical engineering at the University of Michigan, has been named chairman of the aeronautical engineering department of the University of Colorado.

Randall G. Rice, formerly with Chemical Abstracts Service, Columbus, Ohio, has become head of the materials sciences division, Armed Services Technical Information Agency.

E. Ross Hart, of the Veterans Administration Research Laboratories in Neuropsychiatry, Pittsburgh, has joined the research staff at Bionetics Research Laboratories, Inc., Falls Church, Va.

Lester C. Van Atta, former director of the Hughes Aircraft Co. research laboratories, has been named chief scientist at Lockheed Missiles and Space Co., Sunnyvale, Calif.

Alfred A. Messer, former director of the Family Mental Health Clinic, Clifton, N.J., has become professor of psychiatry (research) at Emory University, Atlanta, Ga.

Erratum: In the report "Evaluation of isotope exchange by chromatography" by J. Morávek, Z. Nejedlý, and J. Filip [*Science* **138**, 146 (1962)], the lines "where a is the total concentration of the compound in the reacting mixture [OS*] + [OS]" should have read: "where a is the total concentration of the sulfur in the reacting mixture [SS*] + [SS]".