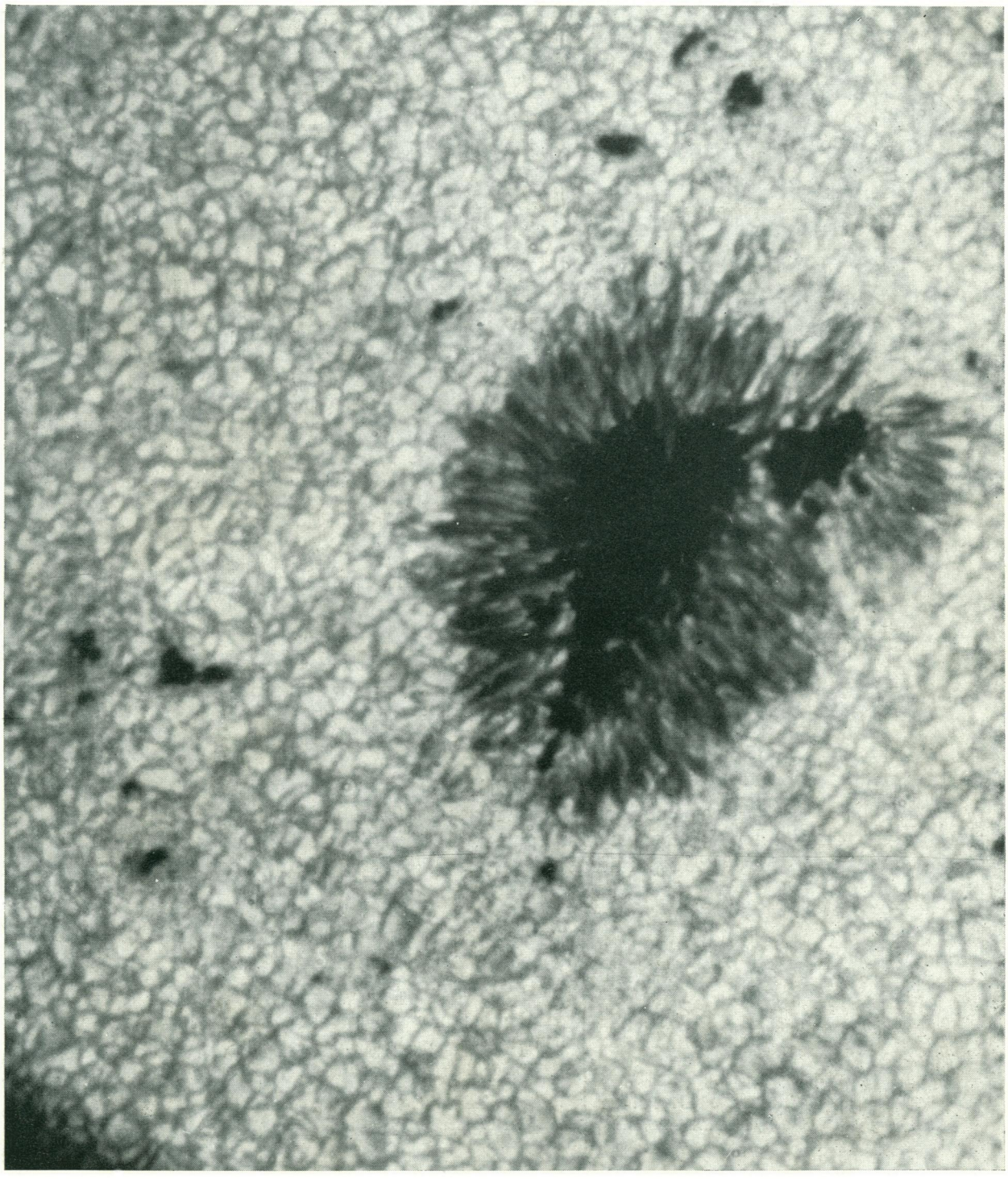
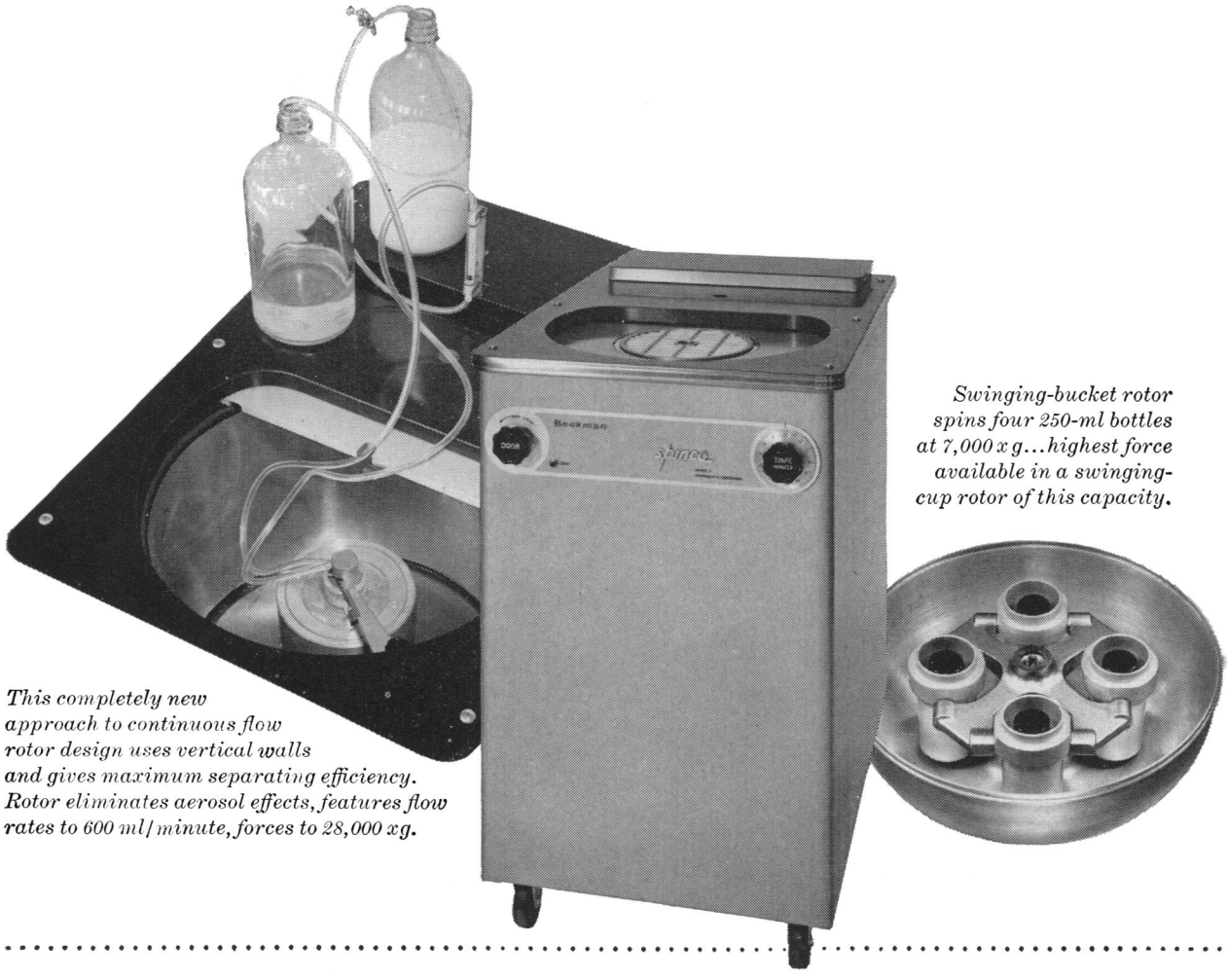
SCIENCE

9 October 1959

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





This completely new approach to continuous flow rotor design uses vertical walls and gives maximum separating efficiency. Rotor eliminates aerosol effects, features flow rates to 600 ml/minute, forces to 28,000 xg.

Swinging-bucket rotor spins four 250-ml bottles at 7,000 x g... highest force available in a swinging-cup rotor of this capacity.

BECKMAN/SPINCO HIGH-FORCE CENTRIFUGE NOW GIVES YOU

* *new continuous flow system*
* *large capacity swinging-bucket rotor*

Those who use the Beckman/Spinco Model K Centrifuge praise its efficient, high-force performance. It is a rugged laboratory workhorse, equally capable of sustained runs at high speeds, or large volume separations at low speeds.

OTHER FEATURES: Rotors to 25,000 rpm... 51,000 x g; automatic operation; braking; powerful, maintenance-free motor; ultracentrifuge-type safety; price, **$1,550**

Beckman®/Spinco Division
Beckman Instruments, Inc.

To: Spinco Division, Beckman Instruments, Inc.
Stanford Industrial Park, Palo Alto 5, California

☐ Please send me complete technical information.

☐ I would be interested in having a Model K on a trial basis; please have a salesman call.

NAME_____

TITLE OR DEPT_____

FIRM_____

ADDRESS_____

S-62

9 October 1959, Volume 130, Number 3380

SCIENCE

Editorial Use of the Ocean 895

Articles Magnetic Storms: *E. H. Vestine* 897
From satellite data should come new understanding of magnetic storms, auroras, and the ionosphere.

Sterile-Male Method of Population Control: *E. F. Knipling* 902
Successful with some insects, the method may also be effective when applied to other noxious animals.

Science in the News Transfer of Projects Gives Air Force Major Role in Military Space Activities; U.S. Specialists Describe Soviet Commitments to Education 905

Book Reviews M. Polanyi's *The Study of Man,* reviewed by *W. Earle;* other reviews 912

Reports Electrical System for Home Conversion and Storage of Solar Energy: *L. J. Giacoletto* 915

Pavlov the Empiricist: *G. Razran* 916

Effect of Dietary Facts on Fatty Acid Composition of Human Erythrocytes and Chick Cerebella: *M. K. Horwitt, C. C. Harvey, B. Century* 917

Experimental Evidence in Support of the Dormant Tumor Cell: *B. Fisher* and *E. R. Fisher* 918

Fusion of Complex Flicker: *J. Levinson* 919

Competitive Antagonism between Kinetin and 8-Azaguanine in *Polytoma uvella: F. Moewus* 921

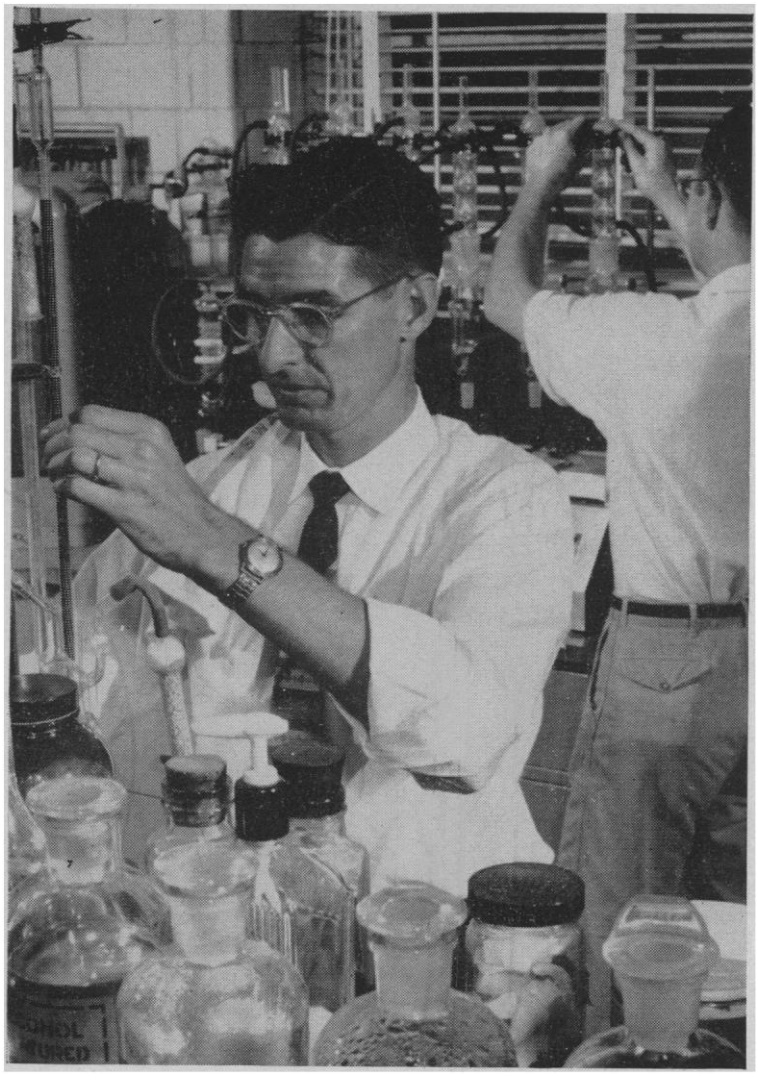
Generator Potential of Insect Chemoreceptor: *H. Morita* and *S. Yamashita* 922

Association Affairs AAAS Chicago Meetings, 1868-1959 923

Departments Letters 890

Forthcoming Events; New Products 926

Cover Sunspot, taken from a balloon at an altitude of 80,000 feet at 11:13 A.M. C.D.T. during the Stratoscope flight of 17 August. Project Stratoscope is an undertaking in high-altitude astronomy headed by Martin Schwarzschild, professor of astronomy at Princeton University, and supported by the National Science Foundation and the Office of Naval Research. The telescope carried by the balloon was designed and built by Perkin-Elmer Corporation, and the television equipment used for controlling the telescope from the ground and for transmitting the images was designed and built by the Princeton Laboratories of the Radio Corporation of America.

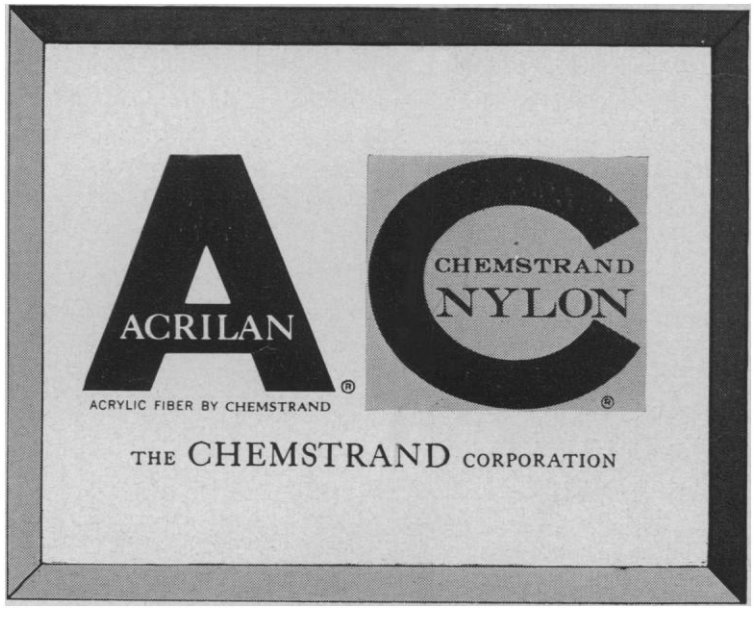


NORTH CAROLINA

Research from the Mountains to the Sea

American Enka Research Center near Asheville developed Tyrex viscose yarn. At the other end of North Carolina International Nickel concentrates its marine research around Wilmington.

NOW CHEMSTRAND . . . After 21 Location Studies

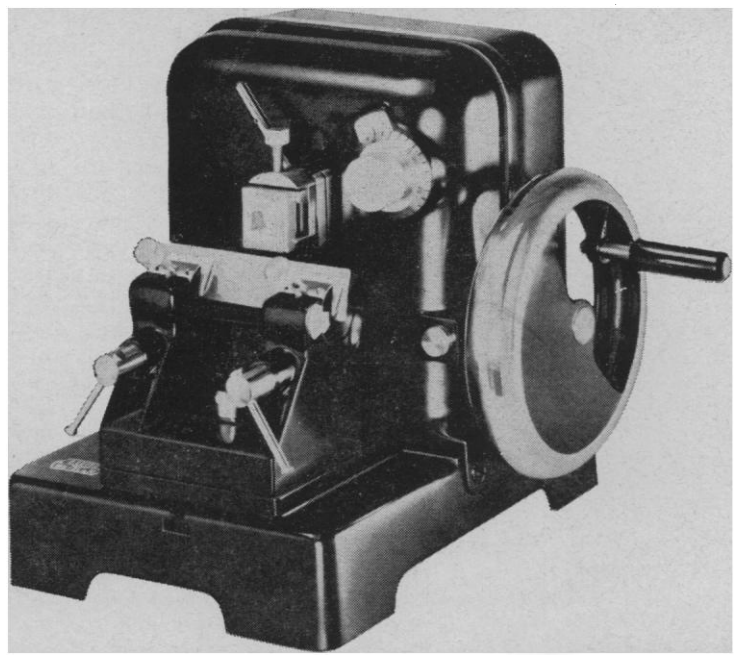


THE CHEMSTRAND CORPORATION, manufacturers of Acrilan acrylic fiber and Chemstrand nylon is locating its research facilities in North Carolina's Research Triangle, where the new Research Park is already mapped for nuclear, chemical, and industrial laboratories. A principal factor in Chemstrand's decision was the stimulating research climate already established in the Triangle, with its proximity to 900 scientists at State College, Duke University, and the University of North Carolina, and to the research staff of the new Research Triangle Institute.

Facilities located from the mountains to the sea enjoy accessibility and availability of the Research Triangle. For information in confidence write WM. P. SAUNDERS, *Director*, Department of Conservation and Development, Raleigh, North Carolina.

NORTH CAROLINA

for dependable, precision microtome sectioning



LEITZ LARGE MINOT ROTARY MICROTOME

The Large Minot Rotary Microtome (#1212) embodies traditional Leitz quality in a heavy design that insures the utmost rigidity and freedom from vibration. This microtome is ideally suited for rapid, accurate, serial sectioning of biological and pathological specimens and for industrial applications such as examination of textile fibers.

- precision micrometer mechanism permits selection of cutting thickness between 1 and 25 microns
- rigid knife blocks with rotating knife clamps, heavy ball-and-socket device for object clamp and paraffin stage
- ball-and-socket clamp permits rapid positioning of the specimen in any direction
- inclination of the knife readily adjustable as required
- adjustable knife block available for producing paraffin sections with obliquely positioned knife
- conveyor belt available for receiving series of sections

Write today for illustrated brochure #53-8, "Leitz Microtomes."

Leitz

E. LEITZ, INC., 468 FOURTH AVENUE, 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 CAMERAS • LENSES • MICROSCOPES • BINOCULARS

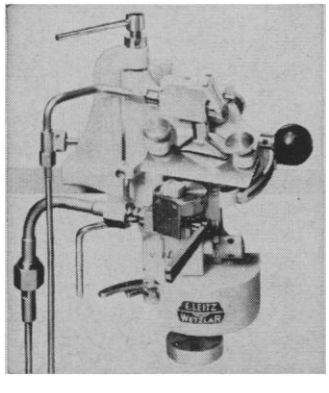
Other Leitz Microtomes:

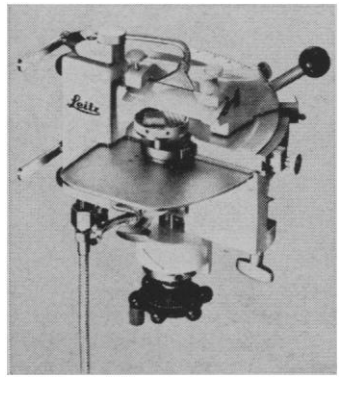
Freezing Microtome (#1213) for sections from 5 to 10 microns in 5-micron intervals.

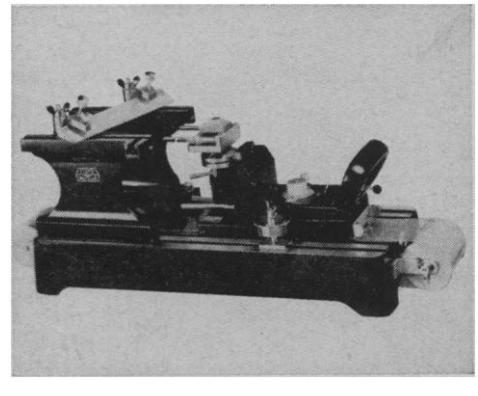
Large Freezing Microtome (#1310) for sections from 2.5 to 50 microns in 2.5-micron intervals.

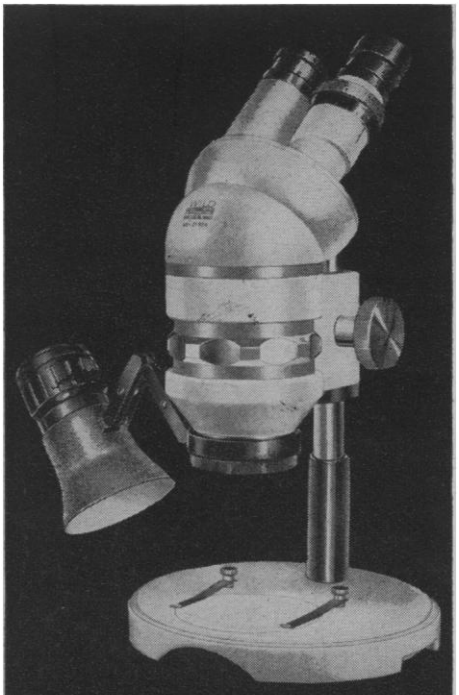
Base Sledge Microtome (#1300) for large and/or very hard sections from 1 to 20 microns thick.

32559









A new achievement for STEREOMICROSCOPY

The WILD* M5 STEREOMICROSCOPE presents, new, important advances in versatility, optics, mechanical conveniences and physical design.

This Swiss precision instrument is equipped with a main objective component followed by pairs of vertically mounted intermediate lenses with parallel axes. The result is increased, uniform sharpness throughout the field, with no need for any change in accommodation.

With a constant working distance of 96 mm., standard magnifications are 6X, 12X, 25X and 50X, conveniently selected on a horizontal drum.

Accessories include a base for transmitted light observation, various light sources, photographic and measuring attachments. A matching steel hood is provided for easy storage and portability.

For full details about this years-ahead stereomicroscope, write for Booklet M5.

*The FIRST name in Surveying Instruments, Photogrammetric Equipment and Microscopes

WILD® HEERBRUGG INSTRUMENTS, INC. Full Factory Services

Main at Covert Street • Port Washington, New York
POrt Washington 7-4843

In Canada
Wild of Canada Ltd., 157 Maclaren St., Ottawa, Ontario

Letters

Probability, Logic and Medical Diagnosis

Ledley and Lusted [*Science* **130**, 9 (1 July 1959)] have suggested the use of mixed strategies in the treatment of patients. While it may sometimes be useful to know the strategy that would be optimum against an intelligent opponent, a doctor would have to be extremely pessimistic to use such strategy regularly. For example, if treatment T_1 has values 3 for disease D_1 and 10 for disease D_2, and if treatment T_2 has values 4 for D_1 and 3 for D_2, then Ledley and Lusted would suggest settling for the value 3⅞. If, instead, one assumes that in the absence of other information both diseases are equally likely to occur, then T_1 has an expected value 6½ and would certainly be chosen. As a patient, I would far prefer that the doctor follow the latter procedure. The use of mixed strategies in games against nature has frequently been suggested in other fields also and usually seems unsatisfactory.

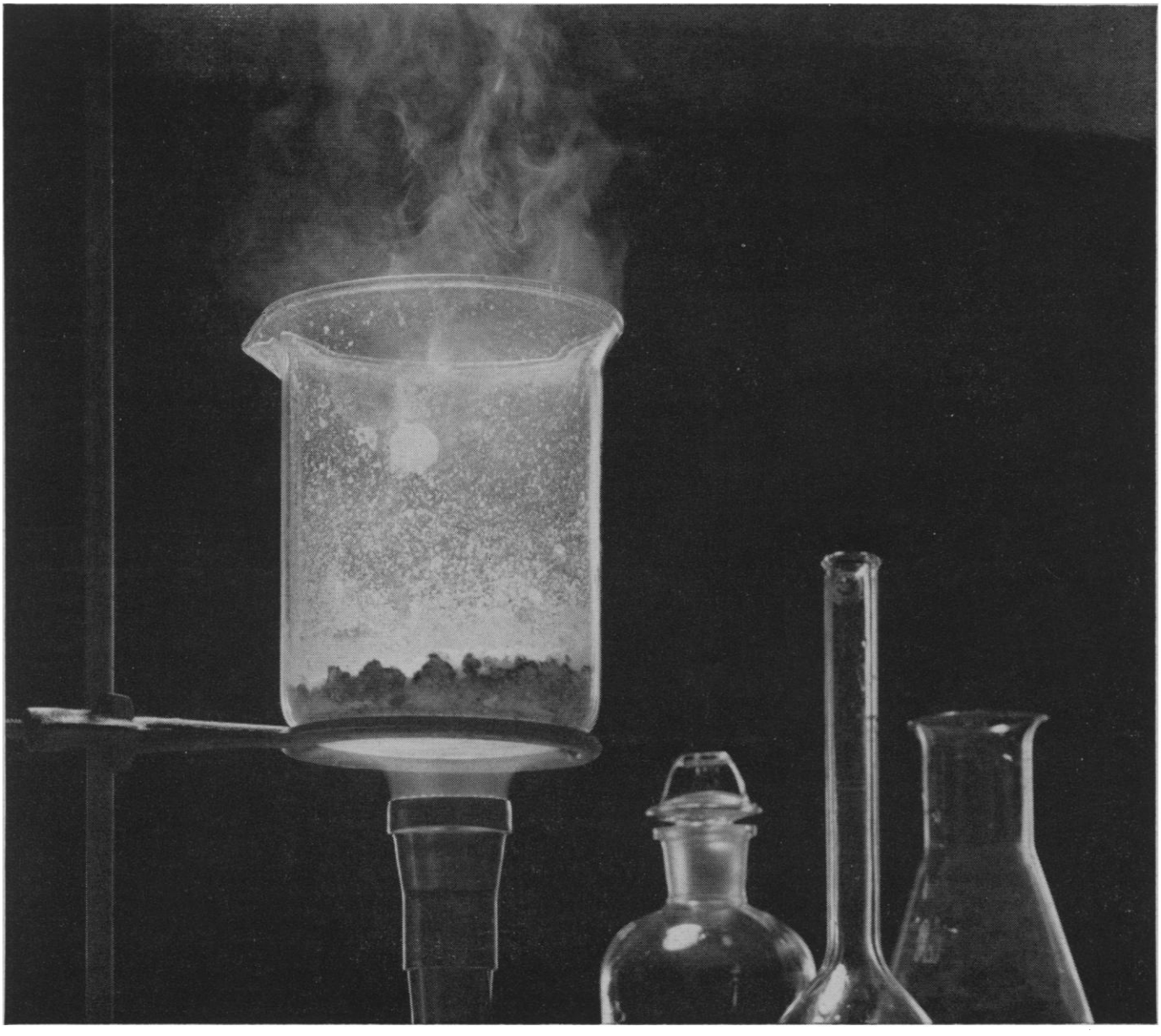
PETER L. BENDER
9606 Bulls Run Parkway, Bethesda, Md.

As a practicing physician who has been interested in the application of Boolean techniques to medicine, I read Ledley and Lusted's article with great interest. The authors' approach to the problem of differential diagnosis is naively simple. Their basic premise appears to be that most difficulties in diagnosis arise because the physician is either not aware of all the possibilities or is insufficiently acquainted with the symptom complexes. While this may be occasionally true, unfortunately most difficulties in diagnosis arise because the patient does not present the *classical* picture. A computer crammed chock full of textbook descriptions of disease, with minute listings of differences in syndromes, will rarely come up with the answer to a difficult problem in differential diagnosis. This stumbling block is fundamental and is inherent in the technical exposition of the authors.

I submit that the authors have handled the data sometimes in the manner of the propositional calculus and sometimes as class algebra, but always as if each variable were universally either true or false. The moment we go from the textbook to the patient, we must quantify. We must say, "some patients having certain symptoms have certain diseases," or even, "sometimes, some of the patients, presenting some of the symptoms, have some of these diseases." Thus, if the statements are properly quantified, the machine will hem and haw like a physician at the bedside.

This is not the time or the place to examine in detail the manner of arriving at a differential diagnosis. Sometimes we deal with diseases which affect many systems; in this case some of the techniques presented by the authors might prove valuable. In other cases a disease affects a particular system, in which case the physician first tries to determine which system is affected (for example, circulatory, respiratory, gastrointestinal) and then tries to pin down the particular entity involved. In many cases it is only by having intimate knowledge of the natural history of the disease, and by following the manifestations as they unfold, that we can arrive at a diagnosis. Many times the symptoms we have learned by rote (and unfortunately there is much of this) completely fail us. The astute physician must fall back upon his knowledge of physiology and disturbed physiology in order to arrive at a logical conclusion.

All this is not to say that a computer approach cannot help us. If a computer were properly programmed, as I am sure it can be, to rearrange medical knowledge into a more useful form, which could then be published, physicians would certainly benefit. A likely approach would be to employ the method of dichotomy. For example, there are probably 30 or more causes for shoulder pain. If we apply a single criterion—that the pain is elicited or aggravated by motion of the shoulder—we can divide these causes into two groups. In the group in which pain is elicited by motion, we apply a second criterion, limitation of shoulder motion and lack of such limitation. In two strokes the 30 possibilities have been reduced to nine. Further grouping on the basis of one or two symptoms would quickly narrow down the range of possibilities. To go through a list of possibilities sometimes enormously larger than this by the method proposed by Ledley and Lusted would require a much greater amount of time and work than the method of dichotomy. I should like to quote from a recent textbook (*1*): "If the set U were to contain 2^{20} (approximately 1 million) logical possibilities and we were able to ask yes-no questions in such a way that the knowledge of the truth value of each question would cut the number of possibilities in half each time, then we could determine with twenty questions any possibilities in the set U." Ashby (*2*) gives an even more striking description of the value of dichotomy. Another likely application for Boolean algebra in medicine would be to simplify criteria for diag-



When the work gets hot — 900°C. hot — try VYCOR® labware

Here's glass that's 96% silica, that has a 1500°C. melting point, that takes a 900°C. thermal down shock without cracking or crazing, that costs less than pure fused quartz labware.

VYCOR ware can be used continuously at 900°C., at 1200°C. with intermittent heating, and up to 1500°C. for one-time use.

It's more stable than borosilicate glasses with hot acids, mild alkalies, water and steam.

There's a complete line of this ware listed at the back of your PYREX® labware catalog — beakers, flasks, crucibles and dishes, ground joints, tubes and tubing, and graded seals for sealing to glasses of higher expansion.

You can add VYCOR ware to your regular PYREX order for maximum discounts. Check your labware dealer for details.

In case you don't have LG-1, the PYREX labware catalog, or Supplement No. 3 to the catalog, we've included a coupon for your use.

CORNING GLASS WORKS
75 Crystal Street, Corning, New York

Send ☐ LG-1 PYREX Laboratory Glassware
☐ Supplement No. 3 to Catalog LG-1

Name.....

Title.....

Company.....

Address.....

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

PYREX® laboratory ware ... *the tested tool of modern research*

Gas
Excitation
for photo chemistry, free-radical production, and spectroscopy with Raytheon's completely packaged microwave power generator systems

Excellence in RAYTHEON Electronics

Raytheon Company
Industrial Apparatus Division
Power Generator Dept. C-10
Manchester, New Hampshire

Please send the following Power Generator material:
☐ Complete specification sheet
☐ Reprints of noteworthy articles
☐ Comprehensive application bibliography

Name
Address
City
Zone State

nosis. The prototypes of this approach are the well-known Venn "club rules" problem (*3*) and the so-called simplification of insurance rules (*4*). Much more could be said about this approach.

Finally, the suggestion that game theory concepts be applied to medicine is an excellent one. It is a pity, however, that the authors, who quote Williams in another connection, do not mention the fact that his remarkable little book published in 1954 put forth this very same suggestion (*5*).

MILTON KUNIN
9410 South Western Avenue,
Los Angeles, California

References

1. J. G. Kemeny, J. L. Snell, G. L. Thompson, *Introduction to Finite Mathematics* (Prentice-Hall, Princeton, N.J., 1958), p. 81.
2. R. Ashby, *An Introduction to Cybernetics* (Wiley, New York, 1957).
3. Quoted in J. T. Culbertson, *Mathematics and Logic* (Van Nostrand, Princeton, N.J., 1958).
4. E. C. Berkeley, "Boolean algebra (the technique for manipulating 'and,' 'or,' 'not,' and conditions) and applications to insurance," *Record Am. Inst. Actuaries* **26**, pt. 2, No. 54, 373 (1957).
5. J. D. Williams, *The Compleat Strategyst* (McGraw-Hill, New York, 1954), p. 122.

The concept of mixed strategies is one of the fundamental concepts embodied in Von Neumann's so-called "game theory." When the strategy of the opponent is *unknown,* a mixed strategy on the part of the proponent will *minimize his maximum loss.* The concept does not require that the opponent be intelligent, as P. L. Bender seems to believe, but rather that the proponent has *no* information about what the opponent will do. If a patient has either disease D_1 or D_2, and if we have no further information, probabilistic or otherwise, then why assume that the chances of his having one disease or the other are equal? Why not assume that the chances are nine out of ten that he has D_1? With no information, the assumptions are equally valid—or, more precisely, equally invalid. As a matter of fact, the article observes that, "in actual practice, some further information bearing on the choice of treatment would be sought—that is to say, the formulation of the problem of which treatment to give the patient is far more complicated than that posed by the single problem discussed above." We then go on to quote J. D. Williams: "Perhaps its [the mixed strategy and game theory's] greatest contribution is . . . the general orientation given to people who are faced with overcomplex problems."

In replying to Milton Kunin, we first want to thank him for his interest in our work. The exposition given in our article was intended for readers who are not primarily mathematicians, but this should not lead Kunin to believe that our treatment of the subject is "naively simple." This is far from true, and judging from Kunin's letter many of the nonsimple aspects of our article evidently escaped his observation. In no way did we imply that the computer should be crammed "chock full" of textbook descriptions of diseases. In fact we devoted a whole section to the "Conditional probability or learning device," suggesting that the computer "learn" from current statistical experience (which of course it will compile from *nonclassical* as well as classical diagnostic "pictures"). It is this statistical experience that comprises the "medical knowledge" often referred to in the article. We even considered in some detail the effects of time and location on such statistical records and noted in the "Conclusions" that such a technique "emphasizes the greater significance and value of current statistics; it depreciates the significance of past statistics." Hence, Kunin's implication that "a computer crammed chock full of textbook descriptions of diseases" is a "stumbling block . . . inherent in the technical exposition of the authors," besides being irrelevant, is simply incorrect.

Another not-so-simple point evidently missed by Kunin is the relationship between logic and conditional probabilities. He seems to imply that we have not taken into account that only "some of the patients having certain symptoms have certain diseases." However, a large portion of the article is devoted to such conditional probabilities of patients with a certain symptom complex having a certain disease complex. In fact we open the section on "Probabilistic concepts" with the following remarks: *"Need for probabilities.* In the previous section we considered statements such as, 'If a patient has disease 2, he must have symptom 2.' While such positive statements have a place . . . , it is also evident that in many cases, the statement would read, 'If a patient has disease 2, then there is only a certain *chance* that he will have symptom 2—that is, say, approximately 75 out of 100 patients will have symptom 2.' Since 'chance' or 'probabilities' enter into 'medical knowledge,' then chance, or probabilities, enter into the diagnosis itself." The use of probabilities and the use of logic are not mutually contradictory, as Kunin seems to imply. In fact the propositional calculus of symbolic logic is one of the cornerstones of the theory of probability.

Finally, Kunin suggests that we use the "method of dichotomy," to use his words. Kunin is correct: The application of symbolic logic to the reasoning foundations of medical diagnosis as described in our article is *precisely* the

(Continued on page 930)

Saves 100 minutes in this heart test

Only Spectronic 20 handles so many tests, so fast . . . at less than half the cost of any other instrument.

You can run assays for Serum Glutamic-Oxalacetic Transaminase in one-sixth the time of other methods—*if you can make photometric readings at 340mμ.* (Karmen, A . . . J. Clin. Invest. 34, 131-33; 1955.)

That means the only colorimeter that can do it is a B&L Spectronic 20. And you actually get the wide, continuous range of a spectrophotometer . . . at less than half the price. Find out which of the eight Spectronic 20 models best fills your needs.

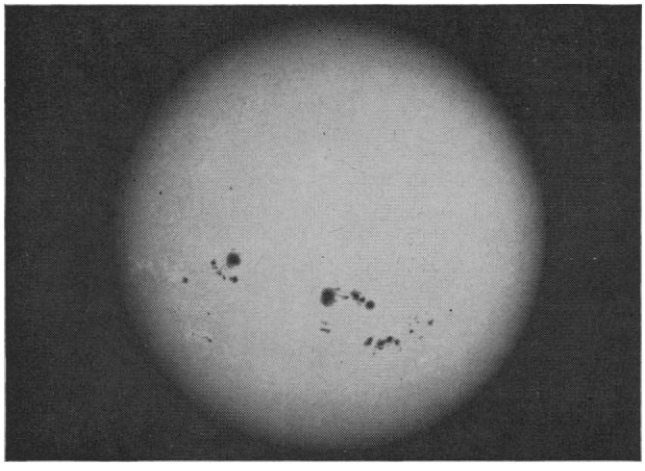
Write for Catalog D-266. Demonstration at your convenience, on your request.
Bausch & Lomb Optical Co., 64246 Bausch St., Rochester 2, N. Y.

BAUSCH & LOMB
SINCE B&L 1853

Kodak reports on:

new life for the old telescope or copying camera . . . a new method of metalworking freedom from phosgene fear . . .

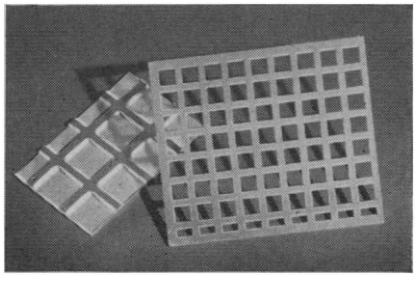
De orbe . . . de urbe



This picture of the solar disk with sunspots and bright faculae was taken on *Kodak Autopositive PB Film* at the prime focus of a 6-inch *f*/15 reflecting telescope at 1/100 second without a filter or any interposed optics. The ¾″ negative image can stand a lot more enlargement. Alas, there is no room for that here, or for an explanation of why this particular film was chosen. To read all about it, send for a preprint of "Photographing the Sun" to Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y. If you've made a reflecting telescope and sometimes wonder why, you may find a soul-satisfying answer in that article.

The space here must serve more pressing needs having to do with another product called "Autopositive," the new *Kodagraph Autopositive Projection Paper*. This paper you put in an enlarger or copying camera and use for reproducing drawings or documents at any desired magnification or minification. Black photographs black, and white photographs white. The negative-to-positive jazz is avoided, and even the conventional hypo fixing bath is replaced by a jet of plain water. For information on where to buy it and how to use it, write Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N. Y.

Photo-milling



New methods of metalworking do not come along often enough to be ignored. Here are two examples of what we call "photo-milling." The one on the right could, of course, have been done on a punch press if die cost had been justifiable. No die was used, nor were the openings cut individually. The one on the left looks like a milling machine job, for sure. It isn't.

This sort of thing is now best done photographically with a new light-sensitive preparation called *Kodak Metal-Etch Resist*. You spray it on, or dip, and dry. Then you expose to bright light under a film on which you have photographed the pattern. After a simple development, a flush that washes away the resist where the pattern kept the light off, and a bit of baking to remove the developer solvent, the metal is ready for whatever chemical or electrolytic etching works best. The resist protects from etching action vigorous enough to remove a quarter-inch of aluminum and considerable depth of stainless steel, tool steel, magnesium, titanium, and possibly some metals we know nothing about. To get the benefit of our thinking on the subject, write Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N. Y.

Small tanks, thanks

The customers simply have to understand our ways. The one who asked for phenyl chloroformate understood. If he had wanted 25 grams, we would have politely written back that the compound was not listed in our catalog. If he had wanted 25 tons, we would have replied with equal politeness that several firms of manufacturing chemists, spotless in reputation, would relish the opportunity to do business with him. (We'll have no tank-car of phosgene wheeled up to *our* window, thank you.) This one wanted 2.5 kilos, so we went

$$COCl_2 + C_6H_5OH \rightarrow ClCOOC_6H_5 + HCl$$

and now *Phenyl Chloroformate* is in our list as Eastman 4914 and at the disposal of even the 25-gram buyer.

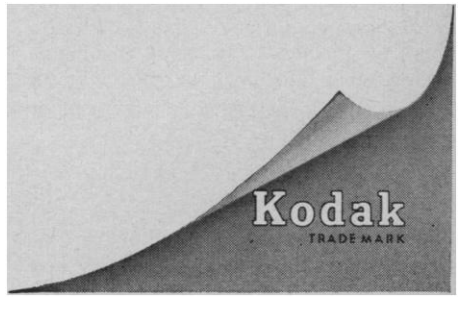
We, in turn, try to understand the customer's situation. Many a chemist just as capable as we of selecting and running the above reaction would just as soon not have a small tank of phosgene next to his file cabinet. (If there is one thing that's more of a burden to have around than a tank of phosgene, it's half a tank of phosgene.)

Here the phosgene (Small tanks, thank you; we're timid.) doesn't sit around long. There must be fifty compounds we make from phosgene —chloroformates, where we replace one of phosgene's chlorines, e.g. the newly added *p-Nitrobenzyl Chloroformate* (Eastman 7819); carbonates, where we replace both chlorines; isocyanates, where we go

$$RNH_2 + COCl_2 \rightarrow RNCO + 2\ HCl$$

Come to think of it, we'll take a back seat to nobody, spotless or otherwise, on cleverness with phosgene.

It would be easy to flatter ourselves by thinking that everyone knows "Eastman" here refers to Eastman Organic Chemicals, and that there are some 3700 of them in stock, and that you do business with Distillation Products Industries, which is a division of Eastman Kodak Company, Rochester 3, N. Y. But, we don't. There must be many chemists who haven't our latest catalog, "List No. 41" on their desks. Are you one?



This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

New Products

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither Science *nor the writer assumes responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to* Science, *Room 740, 11 West 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ CONTINUOUS-FLOW ENLARGING CAMERA accepts originals, which may be opaque or translucent and up to 15 in. wide, either continuously or intermittently. Six enlargement ratios from 2 to 7 are provided. The optical system includes a series of mirrors and a lens. The image is reflected from the surface of the original as the latter moves continuously across a lighted slot at a speed proportional to the enlargement ratio. Sensitized paper passes through the copying point at a fixed speed of 10 ft/min. (Peerless Photo Products, Dept. 124)

■ RECORDER of optical galvanometer type produces a directly visible record immediately at low recording speeds and within 10 sec at high speeds. An ultraviolet source and a special photographic paper are used. The record is stable for weeks under ordinary room illumination and can be fixed by standard methods for permanence. Units with up to 12 channels are available. Writing speeds up to 10,000 in./sec can be attained. (C. H. Stoelting Co., Dept. 125)

■ CORROSION MEASURING INSTRUMENT automatically records corrosion as it occurs. Corrosion is detected by measurement of the ratio of resistance of exposed and protected metal elements mounted on a probe that extends into the corrosive medium under test. The two elements form two arms of a bridge circuit balanced by a servo-driven potentiometer. Range of the recorder is 10 μin. of corrosion (full scale); totalizer dials permit indication of corrosion up to 1000 μin. Balancing and printing are accomplished in 1 min. (Magna Products, Dept. 127)

■ TEST FURNACE of gas-fired type develops temperatures from 2000° to 4300°F. Refractories are made of zirconium oxide. Burners do not require water cooling and operate on natural, liquified-petroleum, or manufactured gas. Preheated air is used for temperatures above 1800°F, and oxygen enrichment permits achievement of temperatures above 3800°F. The furnace is said to be especially useful for testing components such as thermocouples that might be affected by stray currents if an electric furnace were used. (Hirt Combustion Engineers, Dept. 132)

■ STANDING-WAVE DETECTOR measures impedance and voltage-standing-wave ratio from 100 to 1000 Mcy/sec. Specifications include residual voltage-standing-wave ratio less than 1.03; minimum input signal approximately 1 volt at 100 Mcy/sec, 0.1 volt at 1000 Mcy/sec; characteristic impedance 50 ohm. Reactive component sign and voltage-standing-wave ratio are read directly. (Polytechnic Research and Development Co., Dept. 119)

■ VOLTAGE-TO-TIME CONVERTER permits a 1-Mcy/sec counter timer to be used as digital voltmeter. Input voltages from ± 1 mv to ± 100 volts are accepted. Output is two pulses timed to be directly proportional to the d-c input voltage. Conversion with automatic polarity indication is accomplished within 10 msec. Accuracy is said to be 0.05 percent. Addition at a r.m.s.-to-d-c converter permits measurement of a-c voltage. (Systron Corp., Dept. 120)

■ CHROMATOGRAPH permits either isothermal operation or controlled, programmed increase of the temperature of the column during a run. Nine heating rates from 3.3° to 48°C/min are provided. Cooling from 400° to 40°C can be accomplished in 7 min. The preheater is controlled independently to 500°C, and the thermistor detector is maintained at a constant temperature of 300°C. (F & M Scientific Corp., Dept. 108)

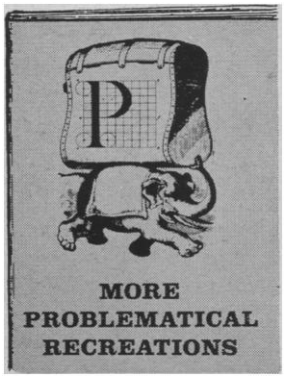
■ METAL LOCATOR for tracing metal pipes and cables includes a transistorized receiver and transmitter, each powered by four flashlight cells. Controls allow adjustment for variation in the conductivity of soil. As stated in the manufacturer's specifications, maximum detecting range is 22 ft and maximum tracing range is 300 ft. The equipment measures 11 by 14 by 8 in. and weighs 12 lb. (Gardiner Electronics Co., Dept. 121)

■ QUARTZ-TUBE VACUUM FURNACE is designed for heat-treating, melting, or sintering operations at temperatures up to 3000°C and pressures of the order of 0.01 μ-Hg. The pumping system includes a 6-in. oil diffusion pump with a water-cooled or refrigerated cold trap. A shielded sight port permits observation and temperature measurement. High-frequency power supply and controls for heating are optional items. (Vacuum Specialties Co., Dept. 122)

■ DUAL RECORDING THERMOMETER is a circular-chart type designed for use at temperatures up to 1100°F. The instrument's two pens operate on a 2-hour differential to avoid interference. Chart diameter is 10 in. Electric and spring-driven chart drives are available. Ten scale ranges are applicable. Elements of the same scale range are interchangeable. (Partlow Corporation, Dept. 131)

JOSHUA STERN

National Bureau of Standards, Washington, D.C.



WIT-SHARPENER

Response to our first collection of these delightfully vexing enigmas has been so heart-warming that we have decided to issue a second volume for your delectation. Write to our Dr. William Jacobi, and ask for "More Problematical Recreations." Gratis, of course.

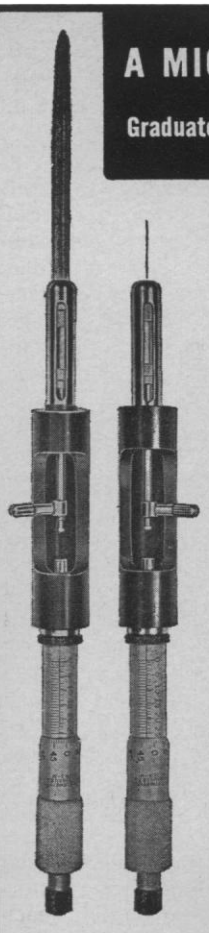
.....

And if you find your fancy tickled by the prospect of working with nationally recognized scientists and engineers in such fields as inertial guidance, radar, tactical data processing systems, airborne digital computers, or space research investigations, you will want to communicate with our Mr. C. T. Petrie.

LITTON INDUSTRIES
Electronic Equipments Division, Beverly Hills, California

A MICRO SYRINGE/BURETTE

Graduated In Units Of 0.0001 ml.



Volume of liquid delivered is precisely measured with a micrometer—down to 0.0001 ml.

Total capacity 0.25 ml.

Volume setting can be maintained for repeated deliveries of identical volumes.

Quickly converted from micro-syringe to micro-burette.

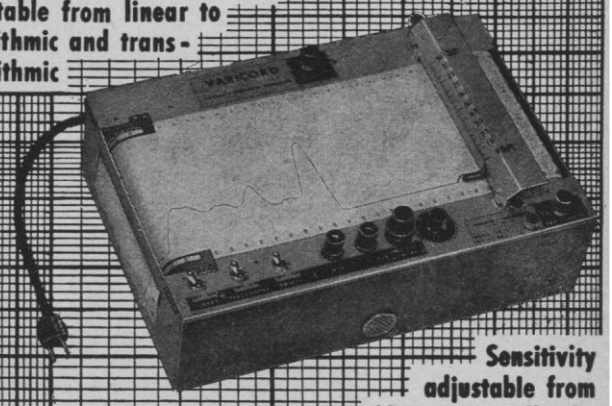
Teflon, glass, and stainless steel construction.

Write for Brochure SM

CALIFORNIA LABORATORY EQUIPMENT CO.
98 Rincon Road • Berkeley 7, California

VARICORD
VARIABLE-RESPONSE RECORDER
for densitometry in paper electrophoresis

Recording function electrically adjustable from linear to logarithmic and trans-logarithmic



Sensitivity adjustable from 10 to 200 millivolts

Designed specifically to be used with scanning densitometers for correctly-compensated quantitative evaluation of electrophoretic patterns on filter paper

Write for Bulletin #1100

Also: Densitometers pH Meters Colorimeters Fluorescence Meters Electronic Photometers Multiplier Photometers

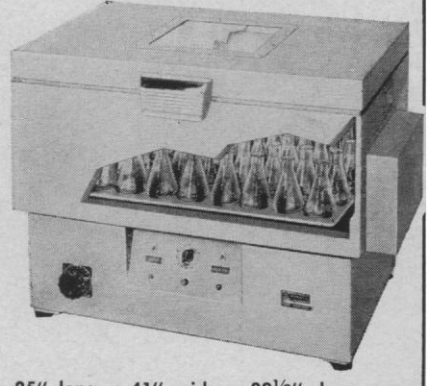
PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

GROW AEROBIC AND ANAEROBIC CULTURES IN THE
GYROTORY®
INCUBATOR SHAKER

A controlled temperature incubator with continuous shaking action. Agitation speed variable from 140 to 400 rpm. Triple-eccentric-shaft stabilizing system distributes positive rotary motion to every flask on the 18″ x 30″ platform. Cool, quiet, smooth-running.

MODEL G25

Circulating heated air, the fully provides constant temperature, ambient to 60° C., ±½° C. Other speed ranges, and connections for gassing available. Adaptable for tubes, bottles, and other glassware.



Overall Dimensions: 25″ long x 41″ wide x 29½″ deep
UNCONDITIONAL ONE YEAR WARRANTY
Write for Catalog G25-S109

NEW BRUNSWICK SCIENTIFIC CO., INC.
PRECISION LABORATORY APPARATUS
P.O. BOX 606, NEW BRUNSWICK, NEW JERSEY

EXCLUSIVE WITH

NEW ENGLAND NUCLEAR
LARGEST PRODUCER OF RADIOCHEMICALS

HIGH SPECIFIC ACTIVITY TRITIATED
PYRIMIDINES AND NUCLEOSIDES

		Specific Activity
NET-29	Cytidine-H^3	360mc/mM
NET-49	Deoxycytidine-H^3	In Process
NET-41	Deoxyuridine-H^3	300mc/mM
NET-27	Thymidine-H^3	1100mc/mM
NET-42	Thymine-H^3	2500mc/mM
NET-50	Uracil-H^3	In Process
NET-28	Uridine-H^3	680mc/mM

Available from stock.

NEW 1959 CATALOG ON REQUEST

new england nuclear corp.
575 ALBANY STREET, BOSTON 18.