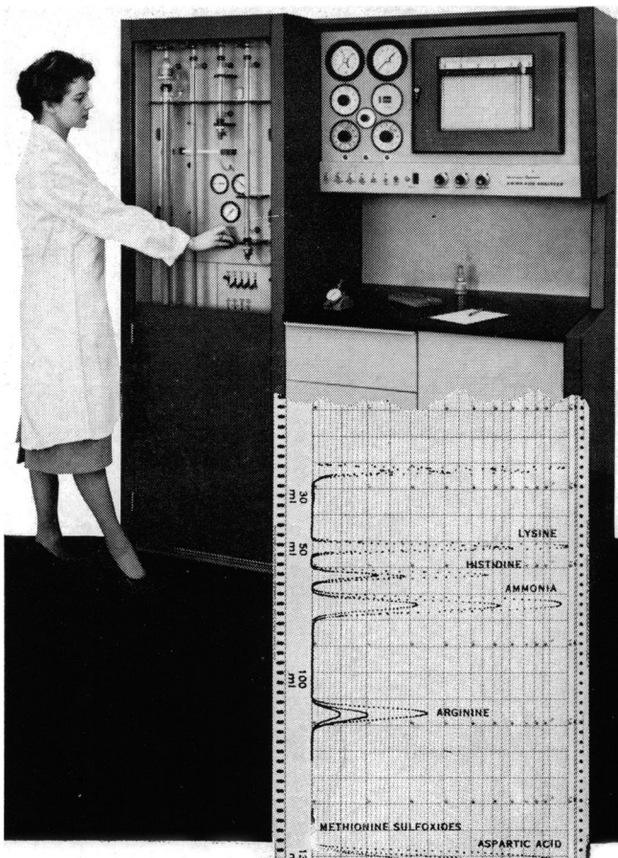
# SCIENCE

22 July 1960

Vol. 132, No. 3421

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

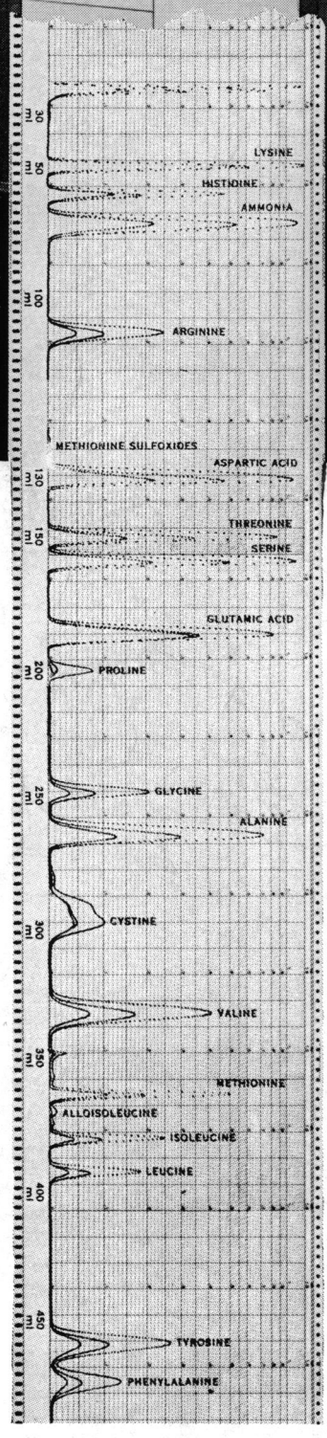



# ANALYZE FOR 20 AMINO ACIDS IN LESS THAN A DAY

*... do it routinely with the Beckman/Spinco Model 120 Amino Acid Analyzer*

*New features include preparative column*

A new Spinco Preparative Column and Stream Divider Accessory is now available for use with the Model 120 Analyzer. In addition, the versatility of the instrument itself has been greatly increased by a new valving system which also allows use of external columns and accessories, including fraction collector and scintillation counter.




*RIBONUCLEASE: Chart of analysis allows precise quantitation of amino acids and related compounds in 3 mg acid hydrolyzate sample of bovine Ribonuclease A. In addition to protein and peptide hydrolyzates, other materials which can be automatically analyzed include physiological fluids, foods, pharmaceuticals and components of plant and microbiological systems.*

Amino acid analyses can be done for you quickly, accurately, *automatically*, by the Beckman/Spinco Analyzer. Simpler runs are finished in less than a day, the most complex within two days.

The instrument employs the Spackman-Stein-Moore technique of automatic recording ion-exchange chromatography. With it a typical analysis takes only half a day of operator time. Five to ten times as many operator hours would be required for analysis by older bio-assay or manual chromatographic techniques.

Compared with earlier analytical methods, operation of the Beckman/Spinco Analyzer is simplicity itself. A small sample is placed on a chromatograph column in the instrument and the analysis is begun. As the sample goes through the Analyzer, a permanent picture is recorded of the amino acids present and their precise amounts.

More than 100 Spinco Amino Acid Analyzers are now in use around the world. If your research involves – or could involve – amino acids, write now for information on this remarkable research tool. Address Beckman Instruments, Inc., Spinco Division, Stanford Industrial Park, Palo Alto 5, California.

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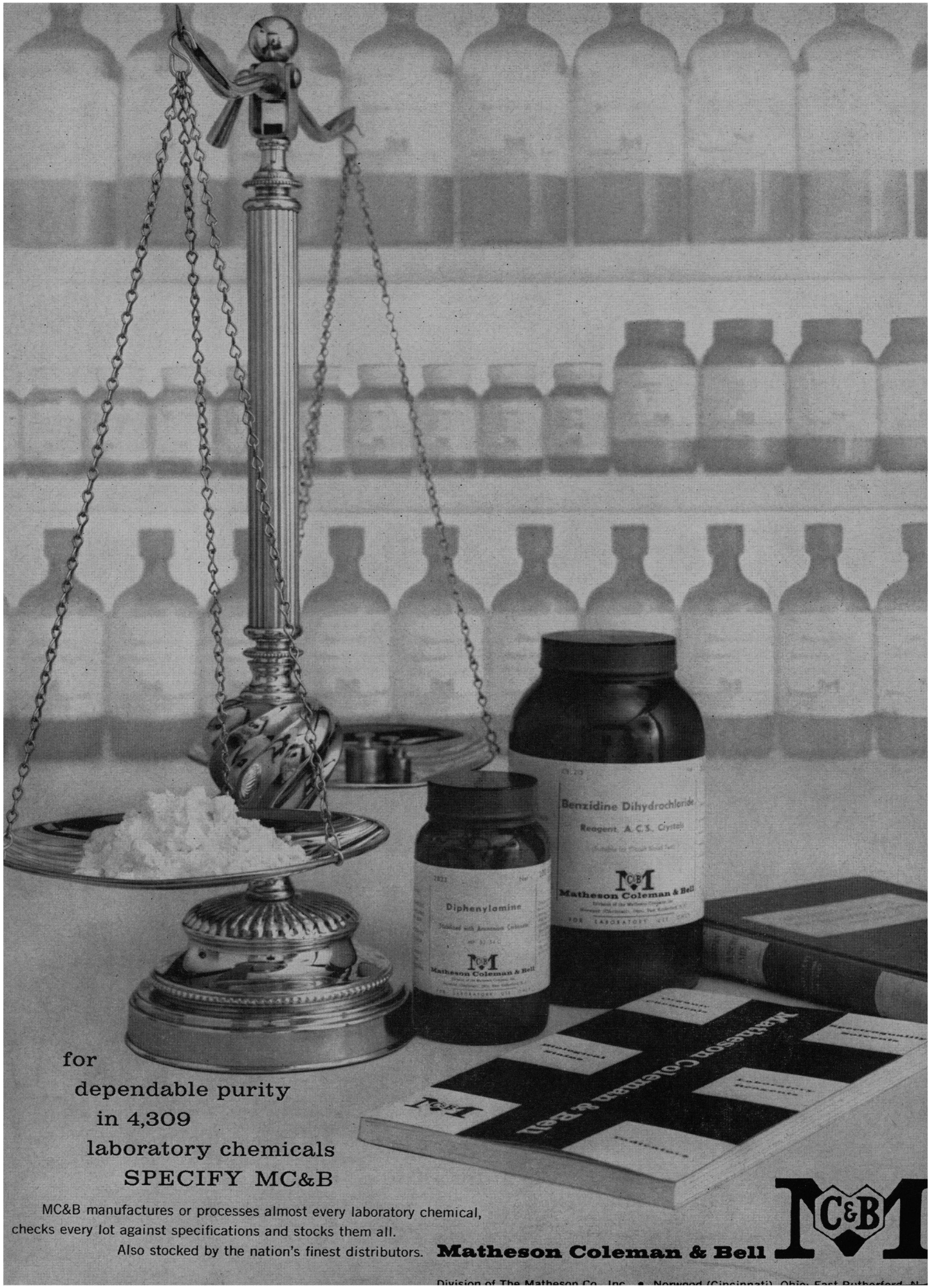


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22 July 1960, Volume 132, Number 3421

# SCIENCE



**Cover**

Air photo of Meteor Crater, Arizona, and the Canyon Diablo Area where coesite has been found by scientists of the U.S. Geological Survey in the course of studying specimens of sheared Coconino sandstone. See page 220. [John S. Shelton, Claremont, Calif.]

Pilâtre de Rozier and Marquis d'Arlandes (November 21, 1783), using a Montgolfier balloon, were the first to leave the earth to test man's physiologic reactions. This experiment was the forerunner of intensive Space Medicine studies of today.

# SPACE MEDICINE

There is a relatively narrow zone above the surface of the earth in which man's physiologic mechanism can function. Hence the unrelenting search by Lockheed scientists into many aspects of Space Medicine.

Engineers already have equipped man with the vehicle for space travel. Medical researchers now are investigating many factors incident to the maintenance of space life—to make possible man's flight into the depths of space. Placing man in a wholly new environment requires knowledge far beyond our current grasp of human biology. Here are some of the problems under investigation: The determination of man's reactions; the necessity of operating in a completely closed system compatible with man's physiological requirements (oxygen and carbon dioxide content, food, barometric pressure, humidity and temperature control); explosive decompression; psycho-physiological difficulties of spatial disorientation as a result of weightlessness; toxicology of metabolites and propellants; effects of cosmic, solar and nuclear ionizing radiation and protective shielding and treatment; effects on man's circulatory system from accelerative and decelerative G forces; the establishment of a thermoneutral range for man to exist through preflight, flight and reentry; regeneration of water and food.

Exploration into unknown areas such as Space Medicine, provides endless stimulation to imaginative scientists and creative engineers. Research at Lockheed's Missiles and Space Division covers the entire spectrum—from pure basic research to development work, in support of current projects. Space Medicine is but one phase of Lockheed's complete systems capability in missiles and satellites. To maintain this position of leadership calls for an extensive research and development program—ranging from electrical propulsion research to advanced computer research, design and development. Typical current projects are: Man in space; oceanography; fuel cells; space station; space navigation; solid state electronics.

**Engineers and Scientists:** If you are experienced in work related to any of the above areas, you are invited to write: Research and Development Staff, Dept. G-44, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

**Lockheed** / **MISSILES AND SPACE DIVISION**

*Systems Manager for the Navy POLARIS FBM; the Air Force AGENA Satellite in the DISCOVERER, MIDAS and SAMOS Programs; Air Force X-7; and Army KINGFISHER*

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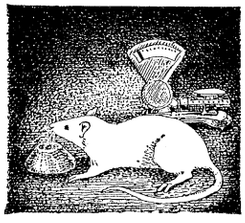
# *IT HAPPENED THIS MONTH...*

*a glance at yesterday in relation to today*

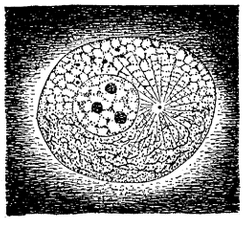
IN JULY—(1922)—the Journal of Biochemistry (Tokyo) reports the isolation and analysis of the prolamin of *Hato-mugi* (Coix lacryma L.). Hato-mugi is an Asiatic species of grass with large seeds called "Job's Tears," which are often strung as beads to pacify teething infants. Results indicate that it contains glutamic acid, leucine, tyrosine and the basic amino acids, arginine, histidine, and lysine, and resembles the prolamin of oats.[1]

*Chemists who know their oats (or their Hato-mugi) will be interested in the Schwarz kit of 18 optically standardized natural amino acids. This kit provides reliable, convenient primary standards for chromatography, microbiological assay and other precise research and instructional purposes. Also available are bulk quantities of optically standardized amino acids for nutritional studies and manufacturing. In addition, most of these compounds are available with $N^{15}$ or $C^{14}$ labels.*



IN JULY—(1929)—Cowgill discusses the physiology of the substance hitherto called "vitamin B."[2] This has recently been shown to consist of at least two physiologically-active factors. One is unstable at high temperatures and is effective in preventing and curing beriberi; the other thermostable component is required along with the antineuritic factor for promoting growth and is probably effective in preventing and curing pellagra.

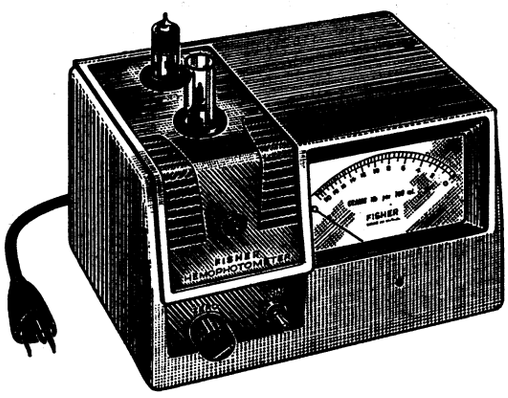
*Today, we know that the anti-beriberi factor is an essential constituent of cocarboxylase (thiamine pyrophosphate), while the anti-pellagra factor is a precursor of catalytic flavins such as flavin adenine dinucleotide (FAD). Schwarz BioResearch supplies both FAD and cocarboxylase, as well as other essential cofactors, including DPN, ATP, and adenylic acid. All are listed in our catalog. Write for it.*



IN JULY—(1959)—discussing the synthesis of organic compounds on the primitive earth, Stanley Miller and Harold Urey state: "The major problems remaining for an understanding of the origin of life are (i) the synthesis of peptides, (ii) the synthesis of purines and pyrimidines, (iii) a mechanism by which 'high-energy' phosphate or other types of bonds could be synthesized continuously, (iv) the synthesis of nucleotides and polynucleotides, (v) the synthesis of polypeptides with catalytic activity (enzymes), and (vi) the development of polynucleotides and the associated enzymes which are capable of self-duplication."[3]

*The fundamental importance of nucleic acids in life processes is now universally recognized. Schwarz BioResearch offers a full line of nucleic acid compounds: DNA, RNA, nucleate salts, nucleotides, nucleosides, purines and pyrimidines, and pentoses. Also available is a complete line of amino acid derivatives, peptides and poly-amino acids. Many of these have been radiolabeled. Do you have our most recent catalog and price list?*

1. Hattori, C. and Komatsu, S.: The prolamin of Coix lacryma L. J. Biochem. *1*:365 (July) 1922. 2. Cowgill, G. R.: Recent studies in the physiology of vitamin B. Yale J. Biol. & Med. *1*:353 (July) 1929. 3. Miller, S. L. and Urey, H. C.: Organic compound synthesis on the primitive earth. Science *130*:245 (July 31) 1959.



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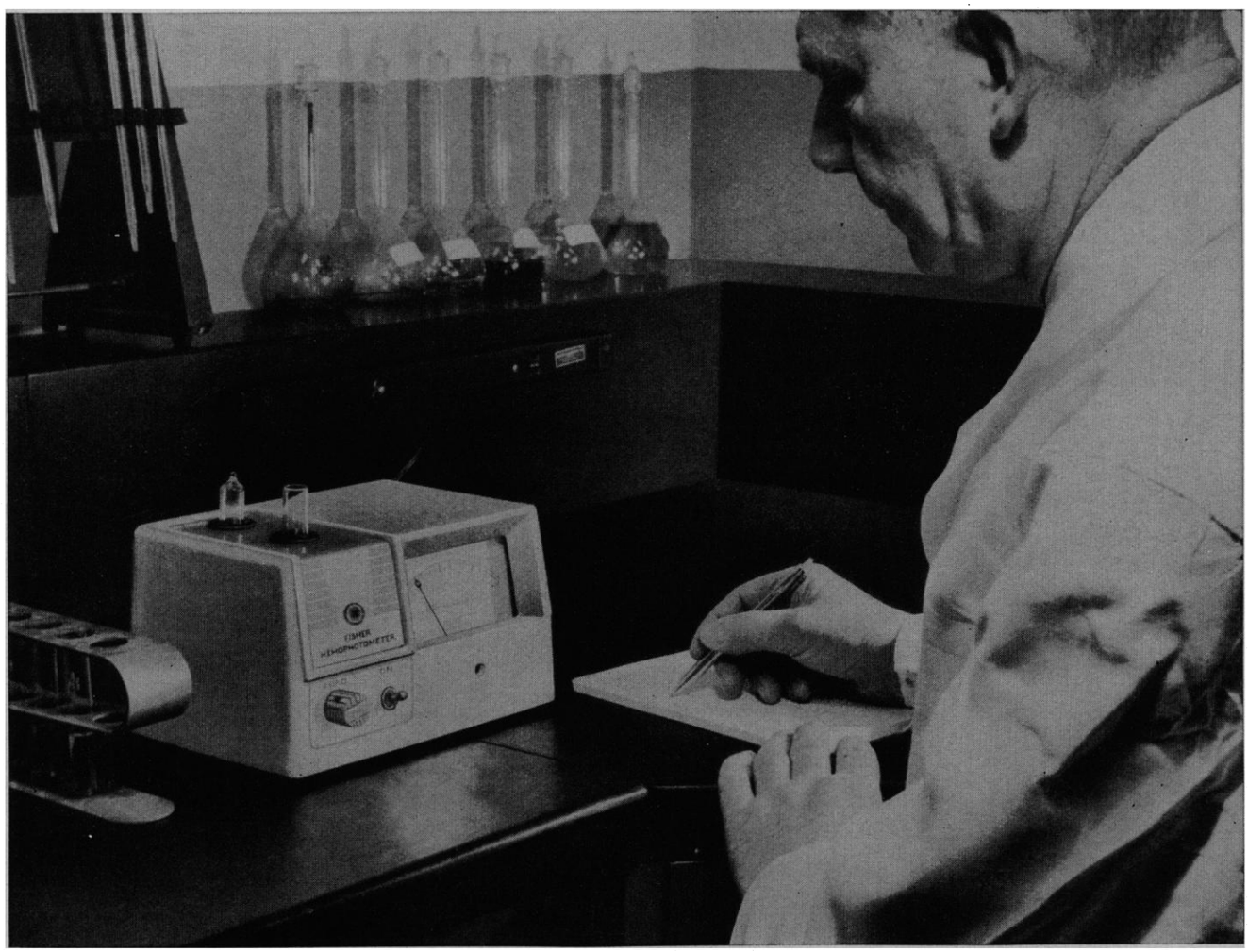

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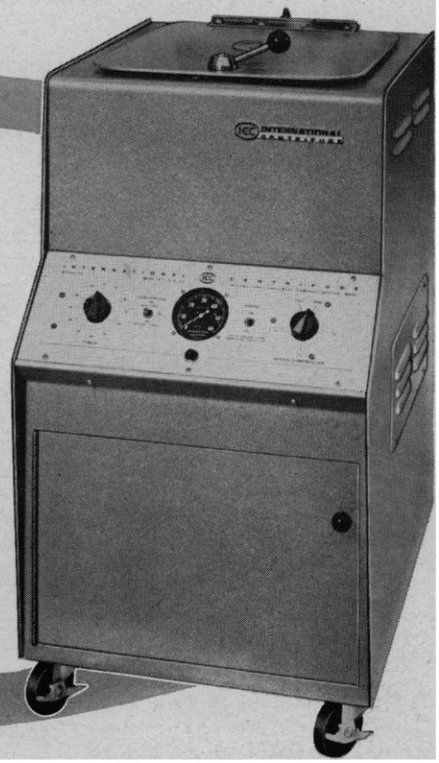

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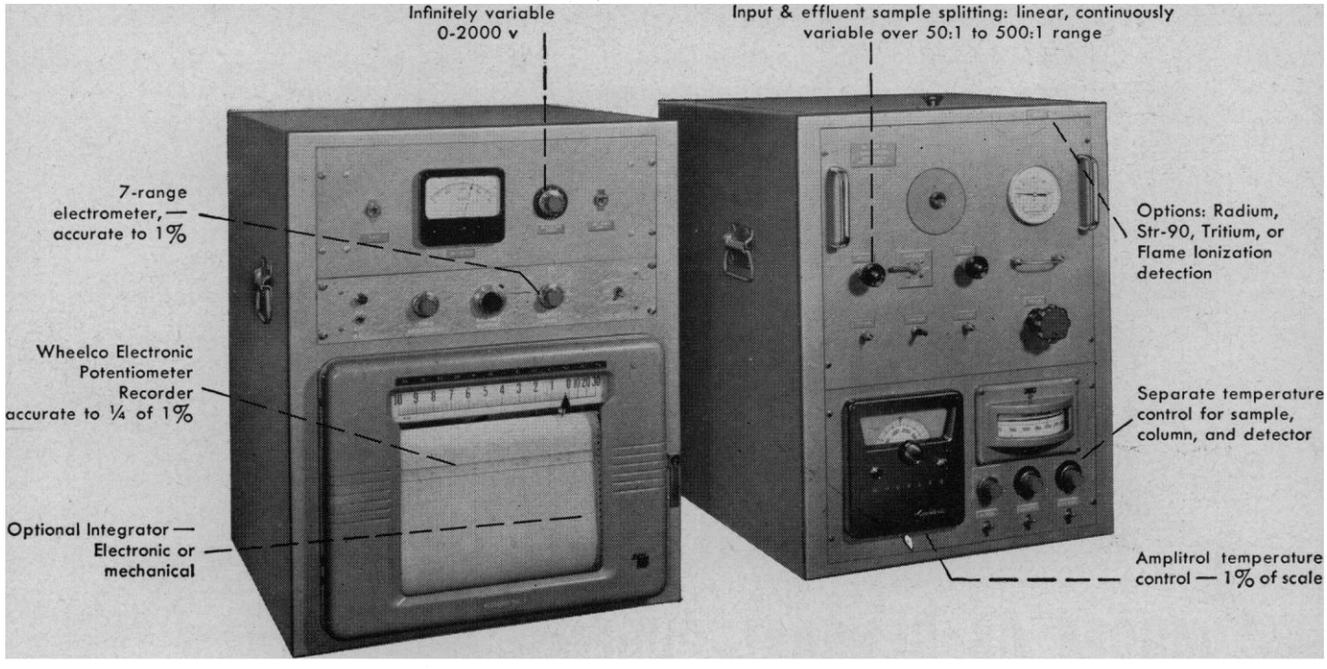


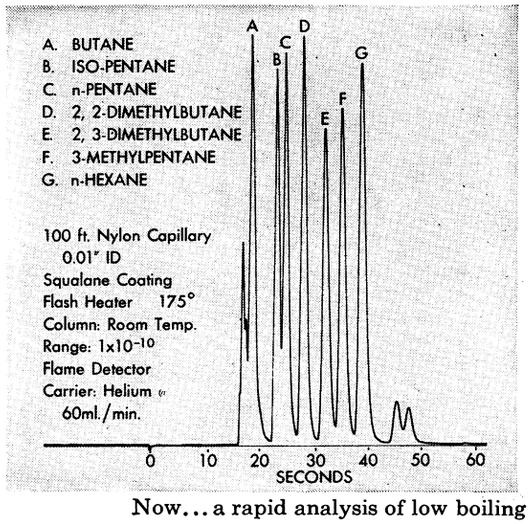


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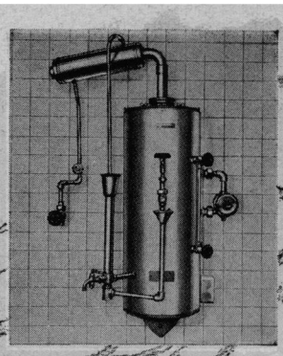

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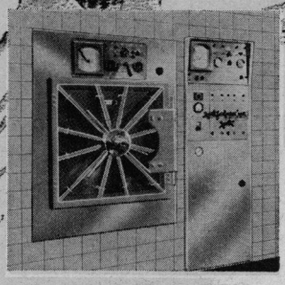

STERILIZERS
Pressure Steam, Gas-Steam,
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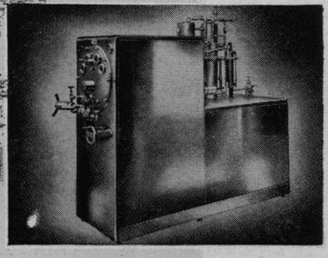
# TALK MICROBIOLOGICAL EQUIPMENT...

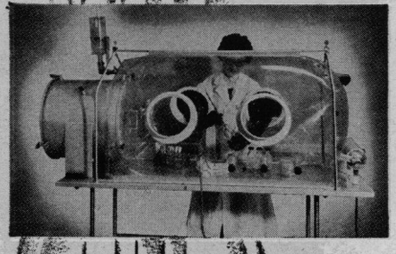


BIOGEN • *continuous culture apparatus*
For batch or continuous culture of pure microorganisms in controlled conditions.

## *and you have to talk to American Sterilizer!*

● Here at Amsco, sterilization is still of prime concern. However, to parallel the great strides of modern biological technology, we've developed a number of highly specialized microbiological devices—all designed to do their job better with less personnel time and attention and at a cost well within practical limits.

If you've a problem in this area, a letter to our Scientific and Industrial Department may lead to its economical resolution.



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# GET YOUR ADVANCE COPY

## of the General Program of the AAAS New York Meeting by first class mail – early in December

The General Program of the 127th Meeting of the AAAS in New York, 26–31 December 1960, will be available to you, at cost, within the first week in December—whether you can attend the Meeting or not.

**Program Content**

1. The two-session AAAS General Symposium, "Moving Frontiers of Science V"—Speakers: Edward Anders, H. W. Magoun and George Wald.
2. The "Challenge to Science" evening with Sir Charles P. Snow and Theodore M. Hesburgh.
3. On "AAAS Day," the three broad, interdisciplinary symposia—Plasma: Fourth State of Matter; Life under Extreme Conditions; and Urban Renewal and Development, arranged by AAAS Sections jointly.
4. The Special Sessions: AAAS Presidential Address and Reception; Joint Address of Sigma Xi and Phi Beta Kappa; the Tau Beta Pi Address; National Geographic Society Illustrated Lecture; and the first George Sarton Memorial Address by Rene Dubos.
5. The programs of all 18 AAAS Sections (specialized symposia and contributed papers).
6. The programs of the national meetings of the American Astronomical Society, American Nature Study Society, American Society of Zoologists, History of Science Society, National Association of Biology Teachers, Scientific Research Society of America, Sigma Delta Epsilon, Society for General Systems Research, Society for the Study of Evolution, Society for the History of Technology, Society of Systematic Zoology, and the Society of the Sigma Xi.
7. The multi-sessioned special programs of the American Association of Clinical Chemists, American Astronautical Society, American Geophysical Union, American Physiological Society, American Psychiatric Association, American Society of Criminology, Association of American Geographers, Ecological Society of America, Mycological Society of America, National Science Teachers Association, New York Academy of Sciences—and still others, a total of some 90 participating organizations.
8. The four-session program of the Conference on Scientific Communication: The Sciences in Communist China, cosponsored by the AAAS, NSF, and ten societies.
9. The sessions of the Academy Conference, the Conference on Scientific Manpower, and the conference of the American Council on Women in Science.
10. The sessions of the AAAS Cooperative Committee on the Teaching of Science and Mathematics, and of the AAAS Committee on Science in the Promotion of Human Welfare.
11. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
12. Exhibitors in the 1960 Annual Exposition of Science and Industry—103 booths—and descriptions of their exhibits.

### Advance Registration

Advance registration has these decided advantages: (1) You avoid delay at the Registration Center upon arrival; (2) You receive the General Program in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; (3) Your name is posted in the Visible Directory as the Meeting opens.

**The following coupon may be used both by advance registrants and by those who wish only the advance copy of the General Program.**

**----------THIS IS YOUR COUPON FOR AN ADVANCE COPY OF THE GENERAL PROGRAM----------**

1a. ☐ Enclosed is $3.50 for my advance Registration Fee which brings me the General Program, Convention Badge, and all privileges of the Meeting (50¢ is for first-class postage and handling).

1b. ☐ Enclosed is $2.50 for only the General Program. (It is understood that, if I should attend the Meeting later, the Badge–necessary for the privileges of the Meeting—will be secured for $1.00 more.)

(check 1a or 1b)

2. FULL NAME (Dr., Miss, etc.) .....
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# APPLICATION FOR HOTEL RESERVATIONS
# 127th AAAS MEETING
## New York, 26-31 December 1960

The five hotels for the AAAS New York meeting have established special, **low, flat rates** and have reserved appropriately large blocks of rooms for this meeting. Thus everyone making room reservations for the AAAS meeting is assured substantial savings.

The list of hotels and the reservation coupons below are for your convenience in making your hotel reservation in New York. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in New York and thereby avoid delay and confusion. The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less.

If requested, the hotels will add a comfortable rollaway bed to any room, at $3.00 per night. Mail your application now to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

### AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

For a list of the headquarters of each participating society and section, see page 230, *Science,* 22 July. Both the Commodore and the Biltmore are AAAS headquarters hotels.

**Flat Rates for Rooms with Bath***

| Hotel | Single | Double Bed | Twin Beds | Suites |
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| Commodore | $ 8.50 | $14.00 | $15.50 | $21.00 to $52.50 |
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| Roosevelt | 8.50 | 14.00 | 15.50 | 39.00 to 43.00 |
| Belmont Plaza | 8.50 | 14.00 | 15.50 | 30.00 and up |
| Waldorf-Astoria | 10.00 | 16.00 | 18.00 | 45.00 and up |

* All rates are subject to a 5% New York City tax on hotel room occupancy.

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**AAAS Housing Bureau**
**90 East 42nd Street**
**New York 17, N.Y.**

**Date of Application** .....

Please reserve the following accommodations for the 127th Meeting of the AAAS in New York, 26–31 December 1960:

**TYPE OF ACCOMMODATION DESIRED**

Single Room ..... Double-Bedded Room ..... Twin-Bedded Room .....

Suite ..... Desired Rate ..... Maximum Rate .....
(Desired rate and maximum rate apply only to suites)

Number in party ..... Sharing this room will be: .....

**(Attach list if this space is insufficient. The name and address of each person, including yourself, must be listed.)**

.....

.....

**First Choice Hotel** ..... **Second Choice Hotel** ..... **Third Choice Hotel** .....

DATE OF ARRIVAL ..... DEPARTURE DATE .....
(These must be indicated—add approximate hour, A.M. or P.M.)

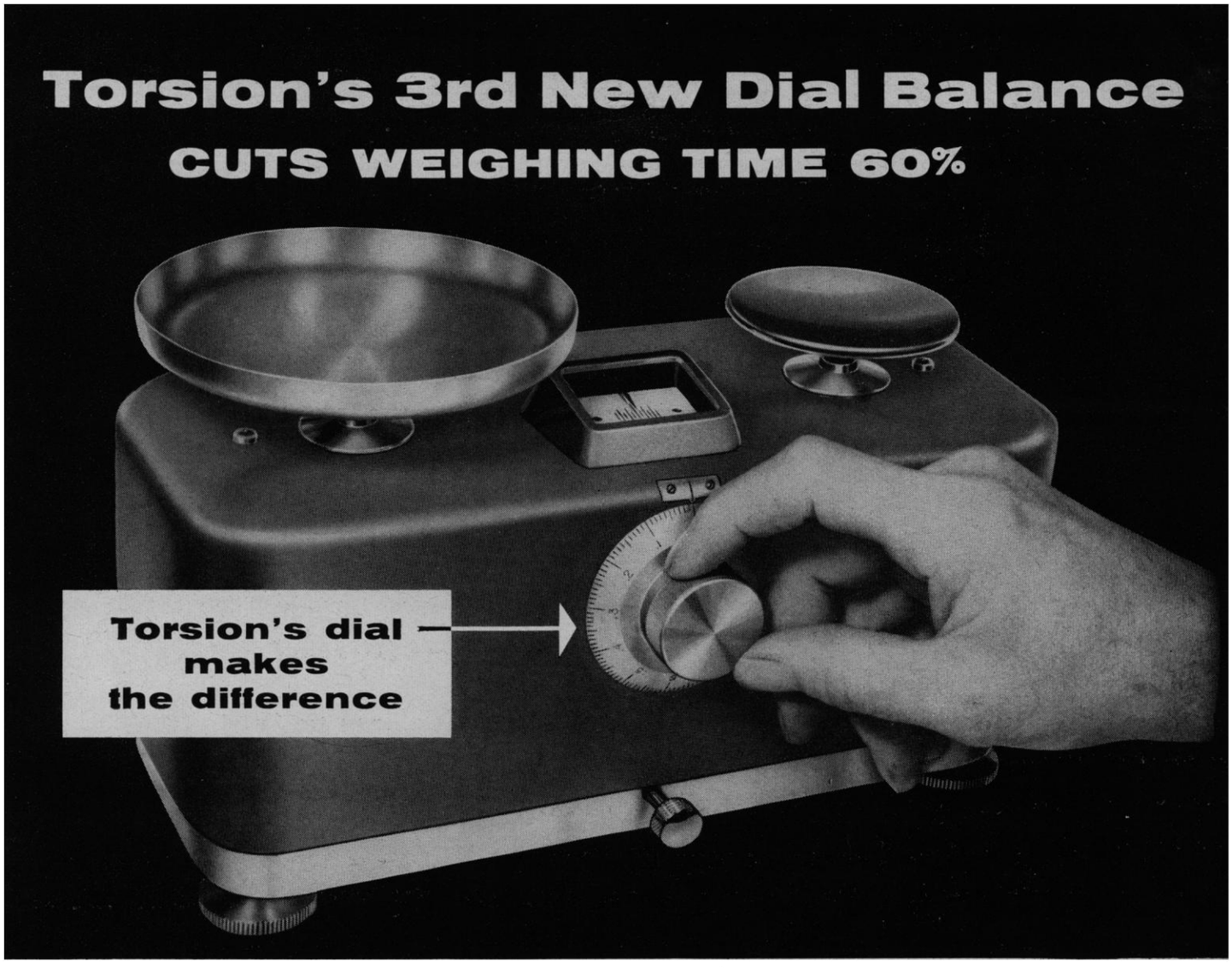
NAME .....
(Individual requesting reservation) (Please print or type)

ADDRESS .....
(Street) (City and Zone) (State)

*Mail this now to the Housing Bureau.* **Rooms will be assigned and confirmed in order of receipt of reservation.**

# Torsion's 3rd New Dial Balance

## CUTS WEIGHING TIME 60%




With Torsion's new 500 gram capacity balance you can make three times as many weighings per hour as before. Here's why:

Conventional laboratory balances use a graduated beam and slide weight for "fine" weighing after the weight has been determined to within 10 grams. Under the old procedure the balance is arrested, slide weight positioned, balance released, balance comes to rest, position of indicator noted, balance arrested again, slide weight repositioned and so on until the weight is determined within 0.1 gram.

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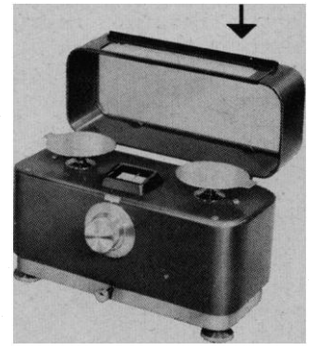
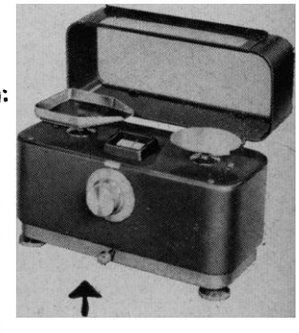
**Torsion Laboratory Balance DLT5**
**Capacity: 500 grams**
**Readability of Dial: .02 grams**

## Other Torsion Dial Balances

**Model DLT2**
**Capacity: 120 grams**
**Readability of Dial: 2 mg.**





**Model DLT2-1**
**Same specifications as DLT2 but has scoop for seeds or other bulky material.**

*The* **Torsion Balance** *Company*

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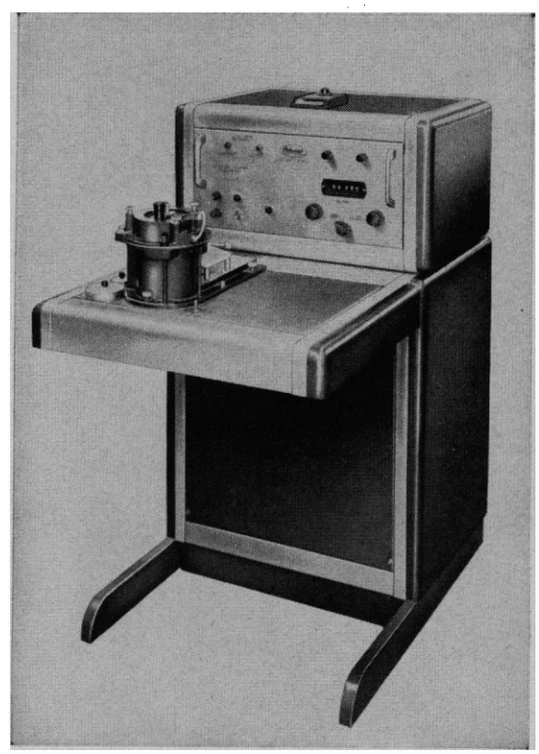
**SCIENTIFIC INSTRUMENTS MODEL RV-2**

**now — for <u>true</u> intrinsic viscosity at extremely low shear rates...**

Scientific Instruments Model RV-2 is a Couette viscometer so sensitive, it permits viscosity measurements to be made at virtually zero shear gradient. The extremely low shear rate capability (0.2 sec.$^{-1}$) of this precision instrument eliminates the obvious errors involved in zero gradient extrapolations from high shear rate measurements.

**USE IT FOR:** molecular weight characterization by intrinsic viscosity; kinetic analysis of enzyme systems; analysis of degree of polymerization, etc.

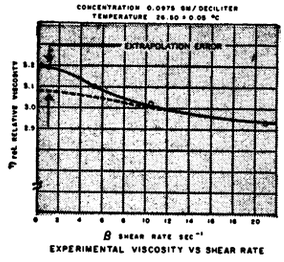


**FEATURES**

* Coaxial rotating cylinders provide even distribution of shear rate
* Operates on principle of electrostatic restoring torque, eliminating torsion wire and mechanical spring problems
* Simple, convenient sample changing
* Rapid, easy selection of shear rates
* Sample temperature automatically maintained within ±0.05°C of desired value
* Cylinder and float made of non-corrosive, non-contaminating material
* Accuracy of viscosity measurement is maintained regardless of liquid density
* Internal standard calibration of restoring voltage

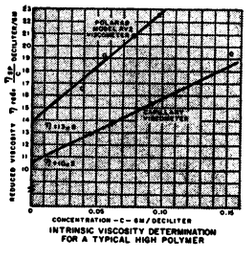
**SPECIFICATIONS:**

**Shear Stress Range**.....0.002 dyne/cm$^2$ to 1.6 dyne/cm$^2$
**Shear Rate Range**.....0.2 sec.$^{-1}$ to 50 sec.$^{-1}$ in 26 steps
**Viscosity Range**.....Up to 800 centipoise at 0.2 sec.$^{-1}$
**Accuracy**.....±0.5% of sample viscosity
**Cylinder Temperature**.....Constant to within 0.05°C of desired temperature when located in a temperature-controlled (±2°C) room



EXPERIMENTAL VISCOSITY VS SHEAR RATE

**Viscosity vs. Shear Rate**
Analysis of viscosity vs shear rate for a water-soluble synthetic polymer demonstrates the effectiveness of this viscometer in measuring the true zero shear gradient viscosity. It can be seen that there was no necessity to extrapolate to zero shear rate because the instrument is capable of viscosity measurements on the plateau approaching this value.



INTRINSIC VISCOSITY DETERMINATION FOR A TYPICAL HIGH POLYMER

**Intrinsic Viscosity Determination For a Typical High Polymer**
Here reduced viscosity is extrapolated to zero concentration to obtain intrinsic viscosity.
Values of reduced viscosity were obtained directly without extrapolation to zero shear gradient. The lower curve is typical of the error to be expected when apparent viscosity is obtained at the high and non-uniform shear rate implicit in the capillary method.

# AUTOMATIC RECORDING TITRATOR

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* Automatic recording pH stat for reaction rate studies
* Titrates to any pre-set end point
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Oxidation-reduction reactions.
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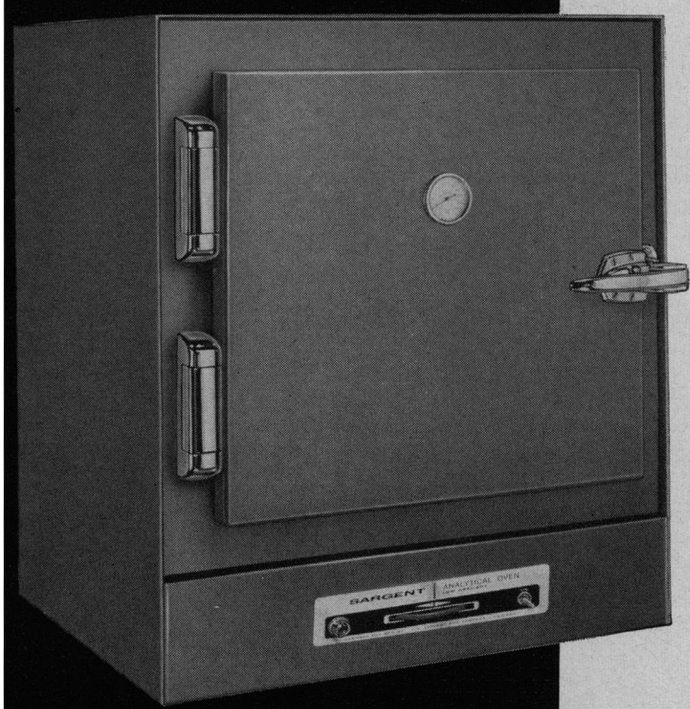
- DIRECT READING, SINGLE TURN TEMPERATURE ADJUSTING DIAL
- OPERATING RANGE, 35° TO 200°C
- ALL INSIDE METAL AREAS AND AIR VOLUME COINCIDENT IN TEMPERATURE WITHIN ± 2½°C WHETHER UNLOADED OR FULLY LOADED
- TEMPERATURE AT ANY POINT CONSTANT WITHIN ±½°C WHETHER UNLOADED OR FULLY LOADED

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**S-64080 OVEN—Analytical, Radiation-Conduction Type, Double Wall, 200°C, Sargent.** A new laboratory analytical oven designed to emphasize conduction and radiation as modes of heat transfer and to minimize the contribution of convection, thereby achieving an unprecedented uniformity of temperature throughout the entire cubic space of the isolated aluminum interior chamber.

The inner chamber is obstruction free. Three removable flat aluminum shelves and a flat bottom area provide over four square feet of useable space for moisture samples.

Heat is applied at a very low gradient and over a wide area from a nickel-chromium ribbon element in woven glass sleeving. 2½ inches of fiber glass insulation results in low wattage requirement and permits temperature to be regulated by a special Sargent heavy duty, bimetal regulator.

Temperature is adjusted by simple rotation of a single turn disk on the lower panel. A dial type thermometer is mounted on the door.

Constructed of heavy gauge, welded steel, finished in baked enamel. Inlet and outlet vents are provided. The oven door automatically opens if pressure builds up inside.

Range, 35° to 200°C; inside width, 14 inches; inside height, 13 inches; inside depth, 12 inches; outside width, 19 inches; outside height, 22½ inches; outside depth, 16 inches; net weight, 60 lbs. Complete with three shelves and thermometer. For operation from 115 volt, 50 or 60 cycle A.C. circuits..... **$165.00**

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22 July 1960, Volume 132, Number 3421

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# Is There Underinvestment in Education?

Belief is widespread that we are not spending enough money on college education in terms of our needs for economic growth, but little systematic research has been done on education as a form of investment. As part of a study for the National Bureau of Economic Research, Gary S. Becker, of Columbia University, has now compared the financial return from a college education with the return from other kinds of investments. The full report is still to be published, but to judge from a preliminary account that appeared in the May issue of the *American Economic Review*, the results will challenge one of our more treasured beliefs. So far as the return to the person getting the education is concerned, Becker finds no evidence for underinvestment. The average return to college graduates is about the same as the average return to business capital.

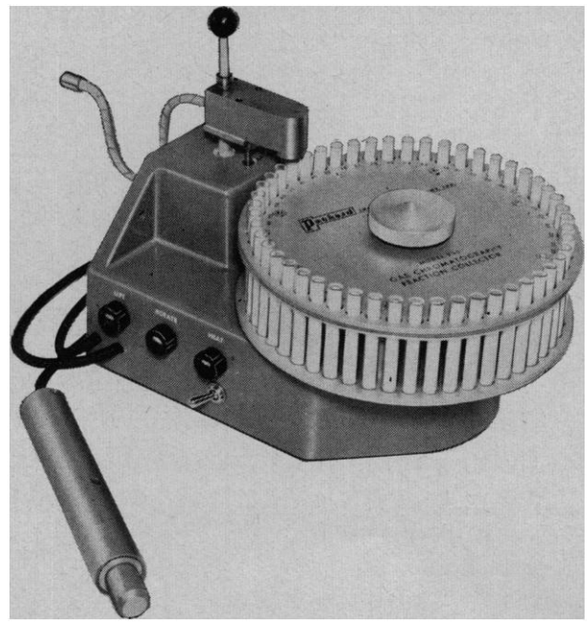
Although the preliminary account gives few details of the computation, there is some discussion of the operations performed. The return from a college education is calculated on the basis of total college costs, not just costs to the student and his family. The income of college graduates, as measured against the income of persons whose education ended at a lower level, is adjusted for such factors as differences in ability. And the study is limited to men, although Becker does suggest that even for those women who expect to do little work outside the home there may be sound economic reasons for going to college. Women who go to college probably secure husbands with higher incomes than women who do not.

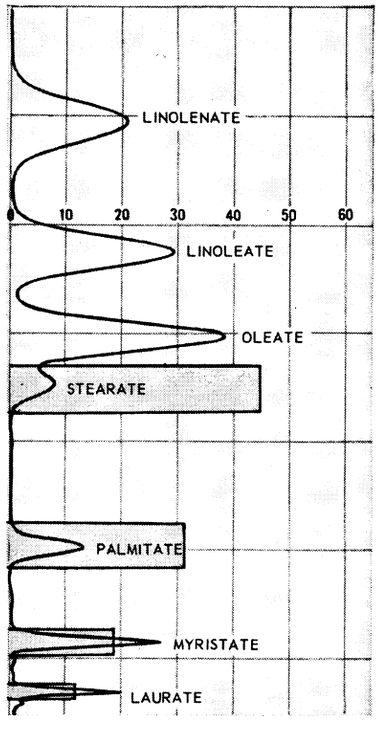
Economists distinguish between direct and external returns, and in the analysis of education this distinction corresponds to that between the effect of a college education on the incomes of persons getting the education and the effect on the incomes of others. The study is concerned only with direct returns, but those arguing that too little is being spent on education can note, for example, that developments in atomic physics are necessary for atomic power and that most atomic physicists are college graduates. To this argument Becker replies that it is easier to give examples of the contribution of science and technology to economic growth than it is to assess the contribution quantitatively or to compare it to the external returns from business capital. In fact, he intimates that, generally speaking, economists know very little about external returns. Consequently, since direct returns indicate no great underinvestment, if the existence of underinvestment is to be argued, the argument must lie in the little explored area of external returns.

The American economy, not to mention American military technology, of course, needs scientists and engineers. To this particular point Becker replies that the special demand for technical experts can be met with a comparatively small increase in the total expenditures on college education. Investment in scientific training is important, but by itself such training is not so very expensive.

To be sure, college attendance offers other rewards besides economic gain; it offers personal enlightenment and preparation for effective citizenship. But restriction of the study to economic considerations no more reflects on these other objectives than it lessens the value of the study as it bears on strictly economic arguments. One comment that has been directed against the study from the economic side is that even if the return to college graduates is the same as the return to business capital, this finding does not necessarily imply that there is no underinvestment in education. The finding might just as well imply that college graduates are underpaid or, to strike an anti-inflationary note, that everyone else is overpaid.—J.T.

# A NEW APPROACH TO PRECISE MEASUREMENT OF RADIOACTIVITY IN GAS CHROMATOGRAPHY






Typical gas chromatogram trace showing mass peaks of fatty acid methyl esters. Superimposed on the mass trace, the bar graph indicates no radioactivity in any of the unsaturates.

The Packard Model 830 Tri-Carb® Gas Fraction Collector enables quantitative collection of individual organic components in a gas chromatographic effluent stream. Precise measurement of radioactivity in component peaks can be made after collection.

An 8″ diameter turntable holds up to 50 Tri-Carb Cartridges, each packed with silicone-coated scintillation crystals. Vapors leaving the gas chromatography mass detector pass through the heated gas injection nozzle of the collector and condense on the coated surfaces of the scintillation crystals. As the operator observes the beginning and completion of each peak on the mass detector trace, he actuates a control switch to change cartridges. Changing takes only a fraction of a second.

After sample collection, the cartridges are placed in positioning adapters in an Automatic Tri-Carb Liquid Scintillation Spectrometer for completely automatic counting. No sample preparation is necessary and up to 100 samples can be handled at one time.

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The chairman of the Committee on Exhibits is William O. Baker, vice president for research, Bell Telephone Laboratories; he was a member of the same committee when the AAAS met in New York in 1956.

The chairman of the Committee on Public Information is Marion Harper, Jr., president of McCann-Erickson, Inc.; he headed the same committee at the previous New York meeting.

The chairman of the Committee on Physical Arrangements is Harry A. Charipper, head of the department of biology, New York University, Washington Square Center, who aided that committee in 1949 and 1956; he is also in charge of local arrangements for this year's meeting of the American Society of Zoologists.

### Housing

Four of the five hotels for the AAAS meeting have established uniform flat rates, much lower than their usual rates, for AAAS members and others attending the meeting. Thus, everyone who makes room reservations through the AAAS Housing Bureau can be assured of substantial savings.

Beginning with this issue, the advertising pages of *Science* will carry, at frequent intervals, announcements of hotel accommodations and rates, together with a coupon which should be filled out and sent, *not* to any hotel directly, but to the AAAS Housing Bureau in New York. All applications for hotel rooms will be filled in the order of receipt. Those who apply early are assured of accommodations in the hotel of their first choice. Expenses can be reduced still further if two people share a room or if three or more people share a suite. Upon request, all hotels will place comfortable rollaway beds in rooms or suites at $3 per night.

### Registration

Both the technical, or program, sessions and the special sessions are open to all interested persons. Although registration for these sessions is not mandatory, it is expected that all who attend will wish to pay the AAAS registration fee of $3 and thus contribute their proportionate share to the heavy expenses of the meeting. (The registration fee for the husband or wife of a registrant, if a second General Program is not required, is $1.)

Each registrant receives the General Program, convention literature, a listing in the Visible Directory of Registrants, and a Convention Badge; the latter assures him all privileges of the meeting, discounts on tickets of admission to tourist attractions, and the like. The badge *is* required for admission to the large-scale exhibits, the AAAS Science Theatre, the presidential reception, and the AAAS Smoker. Re-

freshments will be served at the last two events.

Advance registration ($3.50, since prepaid postage is included) has some decided advantages: Delay at the registration desks upon arrival is eliminated; since the General Program is sent out by first-class mail early in December, the advance registrant can determine at his leisure which events and sessions he particularly wishes to attend; and the registrant's name is posted in the Visible Directory of Registrants as the meeting opens (the hotel room may be added later, by the registrant himself).

An announcement on advance registration, with a coupon, will also be found in the advertising pages of this issue and at intervals hereafter.

### AAAS Headquarters

As stated in the Preliminary Announcement, for the AAAS as a whole, there will be coheadquarters hotels. The Commodore, with its large ballroom, will accommodate the evening events, general sessions, the AAAS business sessions, and the AAAS Pressroom. The Biltmore will house the AAAS Office, the Visible Directory of Registrants, the Annual Exposition of Science and Industry, and the AAAS Science Theatre. Each of the two hotels—located one and a half blocks apart, on two sides of Grand Central Station (they can be reached by underground passages *through* the station)—will have AAAS Main Registration–Information Center facilities.

The Commodore will also accommodate the American Society of Zoologists and Section N; the Biltmore will house the other biological and medical groups and some of the physical sciences as well. The Roosevelt will be headquarters for the American Astronomical Society, for the science teaching societies, and for the social and economic sciences. The Belmont Plaza is the headquarters hotel for geology and geography, Section H, the History of Science Society, and other organizations of the "L" series. At present, no sessions are scheduled in the Waldorf-Astoria, 49th Street and Park Avenue, but 400 of its sleeping rooms are available, at minimum rates.

A detailed list of the headquarters for each section and participating organization is given below, since it is an obvious convenience for each person attending the meeting to have this information before he applies for room reservations.

### Other Hotel Headquarters

AAAS sections are listed alphabetically and societies are listed in the same sequence, by discipline.

*Commodore* (2000 rooms), 42nd Street and Lexington Avenue.

AAAS (Board of Directors, Coun-

cil); General Events and Special Sessions; Pressroom.

AAAS Committee on Science and the Promotion of Human Welfare; AAAS Sections F–Zoological Sciences, N–Medical Sciences, and P–Industrial Science.

American Geological Institute, National Geographic Society.

American Society of Zoologists.

Federation of American Societies for Experimental Biology.

Academy Conference, American Council on Women in Science, Conference on Scientific Communication, National Association of Science Writers, National Science Foundation, New York Academy of Sciences, Scientific Research Society of America, Sigma Delta Epsilon, Society of the Sigma Xi, United Chapters of Phi Beta Kappa.

*Biltmore* (1000 Rooms), 43rd Street and Vanderbilt Avenue.

AAAS Office; Annual Exposition of Science and Industry; AAAS Science Theatre; Visible Directory of Registrants.

AAAS Sections A–Mathematics, B–Physics, G–Botanical Sciences, I–Psychology, Nd–Dentistry, and O–Agriculture.

American Mathematical Society, Association for Computing Machinery, Society for Industrial and Applied Mathematics.

American Astronautical Society, American Institute of Physics, American Meteorological Society, Sigma Pi Sigma.

American Association of Clinical Chemists.

Society of Systematic Zoology.

American Institute of Biological Sciences, American Society of Naturalists, Beta Beta Beta Biological Society, Ecological Society of America, Mountain Lake Biological Station, Nature Conservancy, Society for the Study of Evolution, Society of General Physiologists.

Botanical Society of America, Mycological Society of America, Torrey Botanical Club.

Alpha Epsilon Delta, American Physiological Society, American Psychiatric Association.

American College of Dentists; American Dental Association; International Association for Dental Research, North American Division.

Society for Industrial Microbiology.

American Geophysical Union.

*Roosevelt* (1100 rooms), 44th Street and Vanderbilt Avenue.

AAAS Cooperative Committee on the Teaching of Science and Mathematics.

AAAS Sections C–Chemistry, D–Astronomy, K–Social and Economic Sciences, M–Engineering, Np–Pharmacy, and Q–Education.

American Chemical Society.

American Astronomical Society, Astronomical League.

National Association of Biology Teachers.

American Economic Association, American Political Science Association, American Society of Criminology, American Sociological Association, American Statistical Association, Econometric Society, Metric Association, National Academy of Economics and Political Science, National Institute of Social and Behavioral Sciences, Pi Gamma Mu National Social Science Honor Society, Social Science Research Council.

Engineers Joint Council, Engineering Manpower Commission, Tau Beta Pi Association.

American Association of Colleges of Pharmacy; American College of Apothecaries; American Pharamaceutical Association, Scientific Section; American Society of Hospital Pharmacists; National Association of Boards of Pharmacy.

Institute of Management Sciences.

American Educational Research Association, Council for Exceptional Children, National Association for Research in Science Teaching, National Science Teachers Association, American Nature Study Society.

Conference on Scientific Manpower, National Academy of Sciences–National Research Council, Scientific Manpower Commission.

*Belmont Plaza* (800 rooms), 49th Street and Lexington Avenue.

AAAS Sections E–Geology and Geography, H–Anthropology, and L–History and Philosophy of Science.

Association of American Geographers, Geological Society of America, National Speleological Society.

Conference on Scientific Manuscripts, History of Science Society, Philosophy of Science Association, Society for General Systems Research, Society for the History of Technology.

RAYMOND L. TAYLOR
*Associate Administrative Secretary*

## Forthcoming Events

### August

*15–23.* Soil Science, 7th intern. cong., Madison, Wis. (R. Bradfield, Dept. of Agronomy, Cornell Univ., Ithaca, N.Y.)

*15–24.* Crystallography, intern. cong., Cambridge, England. (W. H. Taylor, Cavendish Laboratory, Cambridge, England)

*15–25.* Chemistry of Natural Products, IUPAC symp., Melbourne, Canberra, and Sydney, Australia. (Convener, Symposium Organizing Committee, Box 4331, G.P.O., Melbourne)

*15–25.* International Geological Cong., 21st session, Copenhagen, Denmark. (IGC, Mineralogical-Geological Museum, Univ. of Copenhagen, Øster Boldgade 7, Copenhagen K)

*15–25.* International Paleontological Union, Copenhagen, Denmark. (J. Roger, Service d'Information Geologique, B.R.G.-G.M., 74, rue de la Fédération, Paris 15e, France)

*15–25.* Sedimentology Cong., 6th intern., Copenhagen, Denmark. [General Secretary, IAS, c/o Institut Français du Petrole, 4, place Bir Hacheim, Rueil-Malmaison (Seine-et-Oise), France]

*16–18.* Biological Effects of Microwave Radiation, 4th annual conf., New York, N.Y. (M. Eisenbud, New York Univ. Post Graduate Medical School, 550 First Ave., New York 16)

*16–19.* Society of Automotive Engineers, San Francisco, Calif. (R. W. Crory, SAE, Meetings Operation Dept., 485 Lexington Ave., New York 17)

*17–19.* Hydraulics Conf., Seattle, Wash. (W. H. Wisely, American Soc. of Civil Engineers, 33 W. 39 St., New York 18)

*17–19.* University Nuclear Reactors, Gatlinburg, Tenn. (University Relations Div., Oak Ridge Inst. of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.)

*17–21.* Ionization Phenomena in Gases, 4th intern. conf., Uppsala and Stockholm, Sweden. (A. Nilsson, Fysikum, Uppsala)

*18–19.* Submarine and Space Medicine, 2nd intern. symp., Stockholm, Sweden. (H. Bjurstedt, Laboratory of Aviation Medicine, Karolinska Institutet, Stockholm, 60)

*20.* American Inst. of Ultrasonics in Medicine, Washington, D.C. (D. M. Stillwell, Dept. of Physical Medicine and Rehabilitation, Univ. of Colorado Medical Center, Denver 20)

*21–24.* Latin-American Cong. of Angiology, Rio de Janeiro, Brazil. (R. C. Mayall, Caixa Postal 1822, Rio de Janeiro)

*21–24.* National Council of Teachers of Mathematics, Salt Lake City, Utah. (M. H. Ahrendt, 1201 16 St., NW, Washington 6)

*21–25.* American Soc. of Pharmacology and Experimental Therapeutics, Seattle, Wash. (H. Hodge, ASPET Dept. of Pharmacology, Univ. of Rochester, Rochester, N.Y.)

*21–26.* American Cong. of Physical Medicine and Rehabilitation, Washington, D.C. (Mrs. D. C. Augustin, 30 N. Michigan Ave., Chicago 2, Ill.)

*21–26.* Physical Medicine, 3rd intern. conf., Washington, D.C. (W. J. Zeiter, 2020 E. 93 St., Cleveland, Ohio)

*21–6.* Pacific Science Cong., 10th, Honolulu, Hawaii. (Secretary-General, 10th Pacific Science Cong., Bishop Museum, Honolulu 17)

*22–25.* American Astronomical Soc., Mexico City, Mexico. (J. A. Hynek, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 38, Mass.)

*22–25.* American Physiological Soc., San Francisco, Calif. (R. G. Daggs, APS, 9650 Wisconsin Ave., NW, Washington 14)

*22–26.* Plasma Physics, symp., Gatlinburg, Tenn. (University Relations Div., Oak Ridge, Inst. of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.)

*22–26.* Western Resources, 2nd annual conf., Boulder, Colo. (M. E. Garnsey, Dept. of Economics, Univ. of Colorado, Boulder)

*23–25.* Assoc. for Computing Machinery, natl., Milwaukee, Wis. (J. Moshman, ACM, Council for Economic and Industry Research, 1200 Jefferson Davis Highway, Arlington 2, Va.)

*23–25.* Cryogenic Engineering Conf., Boulder, Colo. (K. D. Timmerhaus, CEC, Dept. of Chemical Engineering, Univ. of Colorado, Boulder)

*23–26.* American Statistical Assoc., annual, Palo Alto, Calif. (D. C. Riley, ASA, Beacon Bldg., 1757 K St., NW, Washington 6)

*23–26.* Biological Photographic Assoc., Salt Lake City, Utah. (Miss J. H. Waters, Box 1668, Grand Central Post Office, New York 17)

*23-26.* Institute of Mathematical Statistics, annual, Stanford, Calif. (W. Kruskal, Dept. of Statistics, Eckhart Hall, Univ. of Chicago, Chicago 37, Ill.)

*23–28.* American Ornithologists' Union, Ann Arbor, Mich. (H. G. Diegnan, Division of Birds, U.S. National Museum, Washington 25)

*24–27.* Forest Biology Conf., Seattle, Wash. (Miss E. N. Wark, Technical Assoc. of the Pulp and Paper Industry, 360 Lexington Ave., New York 17)

*24–27.* Internal Medicine, 6th intern. cong., Basel, Switzerland. (Secretariat, 6th ICIM, 13 Steinentorstre, Basel)

*24–2.* International Union for the History and Philosophy of Science, Stanford, Calif. (R. Taton, 64, rue Gay-Lussac, Paris 5e, France)

*25–27.* Chemical Organization of Cells, 2nd conf., Madison, Wis. (J. F. A. McManus, Dept. of Pathology, Univ. of Alabama Medical Center, Birmingham)

*25–3.* High Energy Nuclear Physics, intern. conf., Rochester, N.Y. (W. A. Jamison, Dept. of Physics and Astronomy, Univ. of Rochester, Rochester 20)

*27–30.* International Union of Biological Sciences, section of embryology, Pallanza, Italy. (F. E. Lehmann, Kuhnweg 10, Berne, Switzerland)

*28–31.* American Phytopathological Soc., Green Lake, Wis. (W. B. Hewitt. Dept. of Plant Pathology, Univ. of California, Davis)

*28–31.* Potato Assoc. of America, Green Lake, Wis. (R. L. Sawyer, Long Island Vegetable Research Farm, Cornell Univ., Riverhead, N.Y.)

*28–31.* Soil Conservation Soc. of America, Guelph, Ontario, Canada. (H. W. Pritchard, 838 Fifth Ave., Des Moines 14, Iowa)

*28–1.* American Inst. of Biological Sciences, annual, Norman, Okla. (H. T. Cox, AIBS, 2000 P St., NW, Washington 6)

The following 20 meetings are being held in conjunction with the AIBS meeting at Stillwater, Okla.

American Bryological Soc. (G. J. Ikenberry, Dept. of Botany and Plant Pathology, Oklahoma State Univ., Norman)

American Fern Soc. (U. T. Waterfall, Dept. of Botany, Oklahoma State Univ., Norman)

American Microscopical Soc. (R. W. Jones, Dept. of Zoology, Oklahoma State Univ., Norman)

American Soc. for Horticultural Science. (D. G. White, Dept. of Horticulture, Oklahoma State Univ., Norman)

American Soc. of Limnology and Oceanography. (T. C. Dorris, Dept. of Zoology, Oklahoma State Univ., Norman)

American Soc. of Plant Physiologists. (C. L. Leinweber, Dept. of Botany and Plant Pathology, Oklahoma State Univ., Norman)

American Soc. of Plant Taxonomists. (U. T. Waterfall, Dept. of Botany, Oklahoma State Univ., Norman)

American Soc. of Zoologists. (R. W. Jones, Dept. of Zoology, Oklahoma State Univ., Norman)

Biometric Soc. (ENAR). (C. Marshall, Statistics Laboratory, Oklahoma State Univ., Norman)

Botanical Soc. of America. (W. W. Hanson, Dept. of Botany and Plant Physiology, Oklahoma State Univ., Norman)

Ecological Soc. of America. (A. Stebler, Oklahoma Cooperative Wildlife Research Unit, Oklahoma State Univ., Norman)

Genetic Soc. of America. (H. Bruneau, Dept. of Zoology, Oklahoma State Univ., Norman)

Mycological Soc. of America. (J. E. Thomas, Dept. of Botany and Plant Pathology, Oklahoma State Univ., Norman)

National Assoc. of Biology Teachers. (T. Overmire, 1709 Admiral Rd., Stillwater, Okla.)

Nature Conservancy. (A. Stebler, Oklahoma Cooperative Wildlife Research Unit. Oklahoma State Univ., Norman)

Phi Sigma Soc. (D. E. Howell, Dept. of Entomology, Oklahoma State Univ., Stillwater)

Phycological Soc. of America. (I. V. Holt, Dept. of Botany, Oklahoma State Univ., Norman)

Society for Industrial Microbiology. (R. C. Allred, Central Research Laboratory, Continental Oil Co., Ponca City, Okla.)

Society for the Study of Development and Growth. (R. W. Jones, Dept. of Zoology, Oklahoma State Univ., Norman)

Society of Protozoologists. (D. W. Twohy, Dept. of Zoology, Oklahoma State Univ., Norman)

Tomato Genetics Cooperative. (D. G. White, Dept. of Horticulture, Oklahoma State Univ., Norman)

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*28–1.* Association of American Geographers, East Lansing, Mich. (M. F. Burrill, Office of Geography, Dept. of Interior, Washington 25)

*28–1.* Diseases of the Chest, intern. cong., Vienna, Austria. (M. Kornfeld, 112 E. Chestnut St., Chicago 11, Ill.)

*28–2.* Combustion, 8th intern. symp., Pasadena, Calif. (Office of Industrial Associates, California Inst. of Technology, Pasadena)

*28–2.* International Pharmaceutical Federation, Copenhagen, Denmark. (A. W. Tønnesen, Bispebjerg Hospital, Copenhagen, N.V.)

*28–2.* International Soc. for the Welfare of Cripples, world cong., New York, N.Y. (D. V. Wilson, 701 First Ave., New York 17)

*28–3.* Electron Microscopy, European regional conf., Delft, Netherlands. (A. L. Housink, Lab. v. Microbiologie, Julianalaan 67A, Delft)

*28–3.* Histochemistry and Cytochemistry, 1st intern. cong., Paris, France. (R. Wegmann, Institut d'Histochimie Medicale, 45, rue des Saints-Pères, Paris 6°)

*29–31.* American Sociological Assoc., New York, N.Y. (D. R. Young, Russell Sage Foundation, 505 Park Ave., New York)

*29–31.* Clinical Chemists (Canadian and American Societies), annual, Montreal, Canada. (E. Harpur, Montreal Children's Hospital, Montreal)

*29–31.* Electron Microscope Soc. of America, 18th annual, Milwaukee, Wis. (W. C. Bigelow, Dept. of Chemical and Metallurgical Engineering, Univ. of Michigan, Ann Arbor)

*29–31.* Metallurgy of Elemental and Compound Semiconductors, Boston, Mass. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18)

*29–31.* Water Quality Measurement and Instrumentation, PHS symp., Cincinnati, Ohio. (R. T. Hyde, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26)

*29–1.* Ballistic Missile and Space Technology, 5th symp., Los Angeles, Calif. (C. T. Morrow, Space Technology Laboratories, P. O. Box 95001, Los Angeles 45)

*29–1.* Mathematic Assoc. of America, 41st summer, East Lansing, Mich. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

*29–2.* Semiconductors, 5th intern. conf., Prague, Czechoslovakia. (M. Matyas, Inst. of Technological Physics, Cukrovarnická 10, Prague 5)

*29–3.* American Mathematical Soc., natl. summer, East Lansing, Mich. (Miss L.

Charron, AMS, Administrative Services, 190 Hope St., Providence, R.I.)

*29–3.* International Cong. on Low Temperature Physics, Toronto, Canada. (IUPAP, 3, boulevard Pasteur, Paris 15°, France)

*29–3.* International Conf. on Nuclear Structure, Kingston, Ontario, Canada. (L. G. Elliott, Atomic Energy of Canada, Chalk River, Ontario, Canada)

*29–16.* World Forestry Conf., 5th, Seattle, Wash. (I. T. Haig, 5th WFC, Dept. of State, Washington 25)

*31–6.* International cong. de Sociologie, 19th, Mexico City, Mexico. (C. C. Zimmerman, 200 Emerson Hall, Harvard Univ., Cambridge 38, Mass.)

*31–7.* Applied Mechanics, 10th intern. cong., Stresa, Italy. (F. Rolla, Consiglio Nazionale delle Ricerche, Ufficio Relazioni Internazionali, Piazza delle Scienza 7, Rome, Italy)

*31–7.* British Assoc. for the Advancement of Science, annual, Cardiff, South Wales. (Secretary, BAAS, 18 Adam St., Adelphi, London, W.C.2, England)

**September**

*1–3.* Nephrology, 1st intern. cong., Geneva and Evian, Switzerland. (G. Richet, Hôpital Necker, 149 rue de Sèvres, Paris 15°, France)

*1–7.* American Psychological Assoc., Chicago, Ill. (L. F. Carter, 249 Mantua Rd., Pacific Palisades, Calif.)

*1–7.* Nutrition, 5th intern. cong., Washington, D.C. (M. O. Lee, 9650 Wisconsin Ave., Washington 14)

*2–5.* Astronomical League, Haverford, Pa. (R. Dakin, 720 Pittsford-Victor Rd., Pittsford, N.Y.)

*3–10.* International Cong. of Preventive Medicine and Social Hygiene, 8th, Bad Aussee, Austria. (A. Rottmann, Liechtensteinstrasse 32/4, Vienna 9, Austria)

*4–9.* Cell Biology, 10th intern cong., Paris, France. (M. Chèvremont, Institut d'Histologie, 20, rue de Pitteurs, Liege, Belgium)

*4–9.* Laurentian Hormone Conf., Mont Tremblant, Quebec, Canada. (Arrangements Committee, Laurentian Hormone Conf., 222 Maple St., Shrewsbury, Mass.)

*4–10.* International Soc. of Orthopaedic Surgery and Traumatology, 8th cong., New York, N.Y. (A. Bailleux, Société de Chirurgie Orthopedique et de Traumatologie, 34, rue Montoyer, Brussels, Belgium)

*4–10.* World Cong. of Anaesthesiologists, Toronto, Canada. (R. A. Gordon, 516 Medical Arts Bldg., Toronto 5)

*4–14.* International Societies of Hematology and Blood Transfusion, 8th cong., Tokyo, Japan. (S. Murakami, Blood Transfusion Laboratory, Japanese Red Cross Soc., Shibuya, Tokyo)

*5–7.* Society for Biological Rhythm, 7th conf., Siena, Italy. (A. Sollberger, Dept. of Anatomy, Caroline Inst., Stockholm 60)

*5–9.* Chemical Engineering (Czechoslovak Chemical Soc.), Prague, Czechoslovakia. (Technická 1905, Prague-Dejvice, Czechoslovakia)

*5–10.* Microbiology of Non-Alcholic Beverages, 5th intern. symp., Evian, France. (D. A. A. Mossell, Intern. Assoc. of Microbiological Societies, c/o Central Inst. for Nutrition Research, Catherinjnesingel 61, Utrecht, Netherlands)

*5–9.* Medium and Small Power Reactors, conf., Vienna, Austria. (International Atomic Energy Agency, 11 Kärntner Ring, Vienna 1)

*5–10.* Operational Research, 2nd intern. conf., Aix-en-Provence, France. (International Federation of Operational Research Societies, 11 Park Lane, London, W.1)

*5–12.* International Soc. of Bioclimatology and Biometerology, 2nd cong., London, England. (E. M. Glaser, Dept. of Physiology, London Hospital Medical College, Turner St., London, E.1)

*5–15.* International Scientific Radio Union, London, England. (R. L. Smith-Rose, Radio Research Station, DSIR, Ditton Park, Slough, Bucks, England)

*5-17.* Photogrammetry, 9th intern. cong., London, England. (J. B. P. Angwin, Intern. Soc. for Photogrammetry, 18 Cavendish Sq., London, W.1)

*6–8.* Nuclear and Radio-Chemistry, symp., Chalk River, Ontario, Canada. (R. H. Betts, Atomic Energy of Canada Ltd., Chalk River, Ontario)

*6–17.* Use of Radioactive Isotopes in the Physical Sciences and Industry, conf., Copenhagen, Denmark. (International Atomic Energy Agency, 11 Kärntner Ring, Vienna 1, Austria)

*7–8.* Canadian Textile Seminar, 7th, Kingston, Ontario, Canada. (J. M. Merriman, Textile Technical Federation of Canada, 223 Victoria Ave., Westmount, P.Q., Canada)

*7–9.* Canadian High Polymer Forum, 10th, Ste. Marguerite, near Montreal, Quebec, Canada. (D. A. I. Goring, CHPF, Pulp and Paper Research Inst., McGill Univ., Montreal)

*7–9.* International Soc. of Geographical Pathology, 7th conf., London, England. (J. S. Young, ISGP, c/o Dept. of Pathology, Forresterhill, Aberdeen, Scotland)

# 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. A coupon for use in mailing inquiries concerning the items listed is included in the post card insert. Circle the department number of the items in which you are interested on this coupon.*

■ RELAYS are hermetically sealed mercury types said to be capable of operation at temperatures as high as 1200°F. Sliding contacts are used to avoid contact bounce. The relays are filled with dielectric gas of high arc-quenching value. (Sorrels-Johnson Corporation, Dept. Sci627, 363 Rantoul St., Beverly, Mass.)

■ PROPORTIONING PIPETTES use a peristaltic pump to dispense equal aliquots of liquid. One model of the device permits dial selection for automatic delivery of up to 20 multiples of a fixed aliquot per operation. A second model transfers integral multiples of the aliquot until stopped by the operator when the required member appears on a counter. Nominal volume is 0.3 ml/rev. An alternative flexible tube for 0.2 ml/rev is available. Deviation of total volume delivered by a number of revolutions is said to be less than ±1 percent of the mean volume per single revolution. (Baird & Tatlock Ltd., Dept. Sci623, Chadwell Heath, Essex, England)

■ KELVIN BRIDGE measures resistance from 10 μohm to 100 ohm. Test leads more than 100 ft long may be employed with accuracy ±0.25 percent above 100 μohm and ±1 μohm below 100 μohm. Test leads of any length are available with either C-clamp or spring-clamp terminations. (Shallcross Manufacturing Co., Dept. Sci626, Selma, N.C.)

■ GAS DETECTOR is a portable instrument with probe-type detector connected by up to 100 ft of cable. Calibration is in percentage of lower explosion limit of desired gas. An adjustable meter trip provides buzzer alarm actuation. An adjustable current meter allows approximate classification of gas constituents in many gas mixtures. A battery and charger are built in and the instrument may also be operated from a 110-volt a-c source. (Houston Instrument Corp., Dept. Sci628, P.O. Box 22234, Houston 27, Tex.)

■ ADMITTANCE BRIDGE for the range 30 to 300 Mcy/sec uses a thermistor element in a servo feedback system as conductance standard. Accuracy is said to be ±2 percent over the entire frequency range. Capacitance range is ±40 pf and conductance range is 0 to 50 mmho. Voltage applied to the component under test is usually less than 50 mv. Signal sources and detectors are separately available. (Marconi Instruments, Dept. Sci625, 111 Cedar Lane, Englewood, N.J.)

■ RANDOM-SIGNAL CORRELATOR, may be used to measure the normalized cross correlation between two signals, either random or periodic. Frequency range is 2 cy to 250 kcy/sec. Input voltage range is 20 mv to 2 v r.m.s., and gain is continuously adjustable from 1 to 100 in each channel. Accuracy is said to be ±1 percent. An output selector permits selection of either of the two signal channels or of the correlated signal. After the two channels have been equalized, positive or negative correlation can be read directly on an r.m.s. voltmeter. (Flow Corp., Dept. Sci634, 85 Mystic St., Arlington, Mass.)

■ ALIPHATIC ACIDS, their methyl esters, alcohols, and amines from $C_6$ to $C_{18}$ are available with purity said to be 99.5 percent as judged from vapor-phase chromatograms. Purification is effected by vacuum fractionation. (Lachet Biochemical Co., Dept. Sci640, 2202 W. 107th Pl., Chicago 43, Ill.)

■ VOLATILE MATTER DETERMINATION in coal and coke, according to ASTM method D271–48, is aided by apparatus that controls automatically the rate at which the sample crucible is lowered and the length of time it remains in the

furnace. Three dials allow selection from a variety of rates of descent and heating times. Two samples are accommodated by the apparatus at one time. (Laboratory Equipment Corp., Dept. Sci642, P.O. Box 151, St. Joseph, Mich.)

■ THIN SECTIONING MACHINE cuts dentive sections as thin as 35 $\mu$ and crystal sections as thin as 0.005 to 0.10 in. Sections may be cut from specimen blocks ¾ by 1½ by 3 in. in less than 5 minutes. Sections are said to be produced with finished surfaces ready for use in routine examinations without polishing. (Will Corporation, Dept. Sci 644, P.O. Box 3927, Brighton Station, Rochester 10, N.Y.)

■ ADJUSTABLE-LEAK VALVE consists of a vacuum-valve body containing a sealed stem actuated by a vernier drive. A groove machined along the axis of the stem of the valve increases in depth at a controlled rate per unit length. Effective opening ranges from 0 to 0.000024 in.$^2$ and leak rate ranges to 1.8 std cm$^3$/sec for 25 turns of the valve. (Vactronic Lab Equipment, Inc., Dept. Sci 646, East Northport, N.Y.)

■ PULSE GENERATOR produces pulses of ½ $\mu$sec duration at repetition frequencies between 0.5 and 150 Mcy/sec. Pulses can be continuously varied over a 10-to-1 range in steps up to 50 $\mu$sec. Amplitude is 300 volts peak to peak into a 93-ohm load. The unit can be self-triggered or synchronized externally up to 30 kcy/sec. Calibrated delay ranges to 11,000 $\mu$sec are provided. (Arenberg Ultrasonic Laboratory, Inc., Dept. Sci647, 94 Green St., Jamaica Plain 30, Mass.)

■ ANALOG-TO-DIGITAL CONVERTER will directly convert the amplitude of carrier system voltages to digital codes without intermediate a-c-to-d-c conversion. The unit is reversible and as a digital-to-analog converter it converts parallel digital codes to a-c carrier voltages. The amplifier, comparator, and conversion networks will accept frequencies to 100 kcy/sec yielding accuracies said to be ±0.02 percent ±½ count. Units are available for conversion of voltage to 8-to-13 bit binary or to binary-decimal codes of 2, 3, or 4 digits resolution. (Epsco, Inc., Dept. Sci649, 275 Massachusetts Ave., Cambridge, Mass.)

■ HIGH-SPEED CAMERA SYSTEM consists of the camera, camera control unit, light control unit, and flash lamp. In the camera a rotating mirror spun by an air turbine sends the image to the rim of a circular film box. The camera control unit contains the elements necessary for operation of the Kerr-cell

electro-optical shutter. The flash lamp is a standard high luminosity electronic flash unit. Framing rate is 480 to 1.6 million pictures per second, depending on mirror speed and frame size. At the maximum rate, 960 one-quarter frame 35-mm pictures are taken in one run. Exposure time is adjustable from 0.05 $\mu$sec. to 1.0 $\mu$sec, independent of framing rate. Camera and light source are triggered by an external electrical signal. Delay between trigger and start of photography is continuously variable from 0.00004 to 0.01 sec. (Benson-Lehner Corporation, Dept. Sci645, 1860 Franklin St., Santa Monica, Calif.)

■ BLACK BODY INFRARED SOURCE is a miniature unit designed for calibrating the seeking head of infrared guided missiles and other infrared sensitive elements in the 200° to 600°C temperature range. Temperature control is provided by a separate unit which senses the temperature of the radiating core by means of a platinum resistance thermometer. The radiating element is a pure silver core with a conically shaped cavity. The surface of the cone is coated with a refractory material to increase its emissivity to near unity. (Perkin-Elmer Corp., Dept. Sci658 Norwalk, Conn.)



■ MOUSE BREEDING BOXES, made of polyethylene, can be sterilized by autoclave. A smooth finish is said to prevent capillary action, and a built-in nesting feature prevents sticking. Punched lips for drying on washer conveyer are available. (Consolidated Molded Products Corp., Dept., Sci652, 329 Cherry St. Scranton 2, Pa.)

■ DIGITAL DISPLAY UNIT can also serve as a general-purpose oscilloscope. The unit provides a 6- by 10-cm raster presentation of digital data shown as cathode-ray-beam modulation by means of bistable intensity circuits. Positive-going pulses of 2 volts or greater intensify the trace while negative-going slopes of 2 volts extinguish the trace. Horizontal sweeps are generated internally at 5 to 50,000/sec. External sweeps may also be supplied with full-scale deflection produced by 300 mv. Step voltages having amplitudes from 600 mv to 30 volts with rise times up to 0.07 $\mu$sec produce a full-scale vertical raster. (Waterman Products Co., Inc., Dept. Sci650, 2445 Emerald St., Philadelphia 25, Pa.)

■ *p*H METER is a direct-reading instrument incorporating both a 0-to-14 *p*H scale and an expanded scale with 2.0 *p*H full-scale graduated in 0.1 *p*H units. Any 2-*p*H span can be selected for full-scale expansion. *p*H measurements are said to be accurate to $\pm 0.003$ *p*H. Millivolt readings may be obtained over any 200-mv span from 0 to 1400 mv with accuracy said to be $\pm 2$ mv and repeatability $\pm 0.3$ mv. (Beckman Scientific and Process Instruments Division, Dept. Sci643, 2500 Fullerton Rd., Fullerton, Calif.)

■ TIMING SYSTEM includes a crystal- and oven-controlled frequency standard; a frequency divider which furnishes 60 cy/sec; a stroboscope on whose scale WWV signals appear visually for correction to WWV time; a power amplifier to boost the 60 cy/sec signal to 15 watts; a clock and photocell-gated programmer that provides 10-sec, 1-min, 30-min, and 1-hr timing pulses; and a control unit that provides for aural monitoring of signals. Accuracy is said to be within $\pm 0.1$ sec/wk. Operating power is provided by 24-volt batteries. (Geotechnical Corp., Dept. Sci651, P.O. Box 28277, Dallas 28, Tex.)

■ NITROGEN ANALYZER performs automatically the micro-Dumas method of analysis. The operator is required only to prepare, weigh, and insert a sample-packed combustion tube, and adjust and read a counter indicating nitrogen volume. Determinations at levels as low as 0.01 percent are said to be possible with results within $\pm 0.15$ percent of theoretical for routine materials.

Flexible combustion cycles are said to accommodate an almost unlimited variety of organic nitrogen compounds, including heterocyclic nitrogen. Determinations are performed at the rate of four to five per hour. (Coleman Instruments Inc., Dept. Sci654, Maywood, Ill.)

■ ROTARY TUBE ELECTRIC FURNACE is designed for continuous-flow calcining or sintering of ceramic and metal powders. The impervious mullite tube used is adjustable in rotational rate from 0 to 6 rev/min. Hot-zone length is 36 in. and diameter is 4⅛ in. Tilt is adjustable from 0 to 5 in. Operating temperatures up to 2500°F are attainable. Heaters are silicon carbide. (Pereny Equipment Co., Inc., Dept. Sci648, Columbus, Ohio)

■ TRANSFER VOLT-AMMETER measures a-c voltage and current between 5 cy and 50 kcy/sec with accuracy said to be within ±0.05 percent. Full-scale voltage ranges from 0.5 to 300 volts and full-scale current ranges from 7.5 ma to 5.0 amp are covered in two models. Operating principle is the comparison of heating effects of an unknown alternating current with an adjusted direct current and measurement of the latter with a null potentiometer. Internal mercury cells provide the d-c source. (Engelhard Industries, Inc., Dept. Sci659, 113 Astor St., Newark, N.J.)

■ POWER ISOLATOR provides up to 300 v-amp output at 115 volts a-c isolated from line voltage and line ground. A shielded transformer and a feedback isolation circuit are used. Loading of the output to ground is less than 2 pf capacitance and greater than 50,000 megohms. The device is portable and measures 12 by 11 by 6 in. (Moeller Instrument Co., Inc., Dept. Sci660, Richmond Hill 18, N.Y.)

■ TAPE SIMULATOR provides manual entry of data into punched tape systems. The device has a capacity of 80 bits of information, each entered by a pushbutton on the instrument's panel. Arrangement of the buttons in ten lines of eight channels coincides with eight-channel punched-tape code. Pushbuttons light up when depressed. The simulator substitutes for a tape reader for performing check-out and verification functions or may act as an auxiliary signal source. (Hallamore Electronics Co., Dept. Sci655, 714 N. Brookhurst St., Anaheim, Calif.)

■ DATA TRANSFER SYSTEM ultilizes digital techniques for long-distance point-to-point or party-line transfer of analog voltage data over voice-quality transmission circuits. The standard system

provides for transmission of up to three channels of analog information with accuracy said to be ±0.05 percent of full range and resolution of 0.006 percent of full scale at data sampling rates of ten per second in each channel. A wide range of signal levels is accommodated in addition to the standard ±10 volts. Parity checking and identification of data source is permitted. (Vitro Laboratories, Dept. Sci657, 200 Pleasant Valley Way, West Orange, N.J.)

■ RATE TURNTABLE is a portable test unit for mounting rate gyros, antennas, guidance assemblies, and other components requiring imposition of constant rate of turn for performance checking. The basic unit provides a single rate about a vertical axis; modified units provide multiple rates, tilting to polar or horizontal axes, or servo drive. (Sterling Precision Corp., Dept. Sci656, 17 Matinecock Ave., Port Washington, N.Y.)

■ PHASE AND RATIO METER provides simultaneous readings of phase angle and amplitude ratio between two radio-frequency signals. Frequency response is 150 kcy to over 100 Mcy/sec, and threshold sensitivity is 50 mv. The instrument combines a frequency converter with the manufacturer's type 405 phase meter. The converter, used with an external oscillator, converts two radio-frequency signals into audio signals of identical phase relationship and proportional amplitude. Outputs are provided for input to recorders. (Ad-Yu Electronics Lab, Dept. Sci666, 249-59 Terhune Ave., Passaic, N.J.)

■ COUNTER-TIMER, fully transistorized, provides measurement of frequency from 0 to 10 Mcy/sec, time interval and period from 0.3 μsec to $10^8$ seconds, frequency ratio to $10^7$, and phase to 0.1 deg. Readout is by means of in-line electrode tubes. Three d-c amplifiers have 1-megohm input impedance and 0.1-volt r.m.s. sensitivity. Power consumption is 50 watts. (Systron Corp., Dept. Sci661, 950 Galindo St., Concord, Calif.)

■ FLUOROMETER is basically an optical bridge that measures the difference between light emitted by a sample and that from a calibrated light path. A single multiplier phototube within a mechanical light interruptor samples the two light beams and provides an output signal whose phase depends on which of the beams is the stronger. This signal is used to effect balancing of the two beams by means of a cam. About 5 parts of quinine sulfate per billion provides full-scale deflection on the most sensitive range. Linearity is said to be 1 percent and readability 0.5 percent or

better. The instrument may be used as a nephelometer to resolve as little as 0.01 parts of silica per million. (Arthur H. Thomas Co., Dept. Sci674, P.O. Box 779, Philadelphia 5, Pa.)

■ SWEEP-SIGNAL OSCILLATOR furnishes output frequencies from 800 to 1400 Mcy/sec. Output power is 10 mw and output impedance 50 ohms. Output power is held flat within ±1 db over the entire range by a leveler circuit. Sweep operates as 30 cy/sec. Manual tuning over the entire range is also provided. (CGS Laboratories, Inc., Dept. Sci672, Wilton, Conn.)

■ SPECTROPHOTOMETER for the ultraviolet and visible ranges is a fully automatic, double-beam grating instrument. The monochromator incorporates two diffraction gratings, each with 1200 grooves per millimeter. Absorption spectra, reflectance spectra, and emission spectra can be recorded. A single lever positions a hydrogen, tungsten, or mercury lamp for rapid scanning of the ultraviolet spectrum without a break in the record. Speed of wavelength scan is automatically adjusted to the complexity of the spectrum being scanned. (Bausch and Lomb Optical Co., Dept. Sci670, Rochester 2, N.Y.)

■ ELECTRONIC FLASH for high-speed photography delivers a single flash whose duration is controllable to correspond with the writing rate of the camera. Wave form is square with rise and decay times of the order or 40 μsec. Duration settings are 8.7, 11.15, 14.75, and 22.25 msec. (Beckman and Whitley, Dept. Sci673, San Carlos, Calif.)

■ POLAROGRAPHIC INSTRUMENT for process monitoring performs automatic repetitive sampling, analytical pretreatment, and polarographic analysis of liquid from either of two sources, and records the results on a continuous strip chart. Sample and reagent are mixed by a stream of electrolytic hydrogen generated externally. Pretreatment unit and polarographic unit are each housed in steel cabinets and electrically interconnected. The pretreatment unit incorporates automatic pipettes for samples and reagents, polarographic cell, hydrogen inlet valve, mercury receiver, automatic sequence control circuit, power supply, and control panel. Over-all accuracy is said to be ± 5 percent or better. (Baird & Tatlock, London, Ltd., Dept. Sci653, Chadwell Heath, Essex, England)

■ DIAGNOSTIC AUDIOMETER uses a photocell to interrupt tone signals. Interruption is said to be free of accompanying clicks or pings and free of give-away hand motions, a slight movement of the finger being sufficient to start or stop the signal. Frequency range is 125 to 8000 cy/sec. Weight with accessories is 13 lb. (Acousticon International, Dictograph Products Inc., Dept. Sci662, Jamaica, N.Y.)

■ OSCILLOSCOPE DOLLIES provide a 20-deg viewing angle. Storage areas are provided for preamplifers, and a drawer for accessories. A rubber gasket prevents damage to instruments while installing or removing. Casters are 5 in. in diameter, rubber tired and ball bearing. Three power outputs and one input are included. (PBR Manufacturing Co., Dept. Sci663, 861 E. Luzerne St., Philadelphia 24, Pa.)

■ VOLTAGE-TO-FREQUENCY CONVERTER develops a frequency proportional to input voltage with long-term accuracy said to be within ±0.1 percent. Frequency range is 0 to 100 kcy/sec. Full-scale range can be switched from 0.1 volt through 1000 volts in five steps. Input polarity is automatically indicated. Models are available for rack, module, or cabinet mounting. (Vidar Corp., Dept. Sci664, 2107 El Camino Real, Palo Alto, Calif.)

JOSHUA STERN

*National Bureau of Standards, Washington, D.C.*

# Letters

## Artificial Biosphere

It is unfortunate that Dyson's suggestion [*Science* **131**, 1667 (1960)] as to how intelligent beings might survive after reaching "the limits set by Malthusian principles" does not do justice to the intelligence of these beings by explaining how they would overcome some of the obstacles which, at first sight, would seem to militate against their curious way of life.

Dyson's report describes a uniformly thick shell of fluid with a thickness of a meter or two and a radius twice the earth's distance from the sun. The shell is said to revolve about the central star, which implies that the material revolves as a whole. Presumably the material of the shell must be enclosed on both surfaces by transparent plastic sheaths of similar constructions, for self-gravitation cannot be expected to make the material cohere. However it is not conceivable that it would be possible to quarry from the material of a planet like Jupiter sufficient structural steel to keep the shell rigid against the shear forces and those that would tend to move material towards the equatorial plane.

Therefore, it must be assumed that radiation pressure must play a part in supporting the shell, so that its form will be that of an oblate spheroid rather than a sphere. For example, material at the poles of revolution of the shell would be supported entirely by radiation pressure, so that the polar radius of the shell would necessarily be less than the equatorial radius. However, a cursory calculation will show that this would be possible only at a distance from the central star comparable to but less than the radius of the sun.

Beings of lesser intelligence, not having discovered the appropriate laws of physics, might therefore seek some other distribution of their dismantled Jupiter that would have more intrinsic stability—for example, a torus lying in a plane perpendicular to the axis of its own rotation. The mass of Jupiter distributed in this way would yield a torus whose cross-sectional area was comparable with that of the moon, but unfortunately the flux of stellar radiation would be reduced by a factor of $10^9$.

With conventional laws of physics, however, as Laplace was the first to show, even this arrangement would not be stable, and it is to be expected that the material of the torus would coalesce into one or more planetary objects. This suggests that, in the present state of intelligence, the dispersal of Jupiter into a thin shell about the sun would

not be an effective means of escaping the consequences of continued population growth but that it might be an experiment with an important bearing on various theories of the origin of the solar system. It would, for example, be interesting to see whether the outcome of the experiment was the recreation of Jupiter or the creation of a number of asteroids.

Another point is that a search for infrared stars would be valuable even in conventional science for the light it might throw on the evolution of stars which are very young or very small as compared with the sun.

JOHN MADDOX

*Washington* Post,
*Washington, D.C.*

Freeman Dyson's report suggesting that intelligent life elsewhere in the universe may be detected by looking for sources of infrared radiation was delightful. However, as an old science-fiction hand, I feel obliged to sound a cautionary note to the scientists. Or am I merely too dense to recognize a satire?

The basis of Dyson's argument is that an industrial culture may eventually occupy an artificial biosphere completely surrounding its sun, thus maximizing the territory and energy available for population expansion "to the limits set by Malthusian principles." The mass of Jupiter could be converted into an inhabited "spherical shell revolving around the sun at twice the Earth's distance from it," utilizing incident solar radiation which would be reradiated into space in the 10-micron band.

Offhand, I should think rotational and gravitational stresses alone would rule out such a structure of such dimensions. But since it is admittedly dangerous to assert that anything is impossible, I shall confine myself to questions of economics. Even Dyson intimates that the project would take several thousand years to complete; he calculates the energy required as equal to the sun's total output for eight centuries, and one does have to eat meanwhile. And meanwhile, too, the population growth necessitating this project will presumably continue. As Hauser remarks in the same issue [*Science* **131**, 1642 (1960)], at our present-day rate of increase we would reach "a population of one person per square foot of the land surface of the earth in less than 800 years." Thus, the economic surplus needed for the biosphere project would be consumed long before the latter got well started.

If we assume a ratio of population increase to industrial expansion low enough so that this contretemps does not occur, we must ask ourselves how

any intelligent species could be induced patiently to continue this enormous task, millennium after millennium. True, our human history contains epochs of grandiose and useless construction, such as the pyramid building of Egypt, but they never lasted very long. Any revolutionist who promised relief from the crushing burden of the biosphere project would be well received! He could doubtless get support for some or other population-control program; those who demurred would be martyred by exasperated taxpayers, or the equivalent thereof.

Of course, the entire species *might*, by advanced psychological techniques, be conditioned into such an antlike state that its government could never be overthrown, or break down from internal stresses, or evolve into something new. But given subjects as meek as this, and no reason to breed vast armies (for only a well-established world government could seriously entertain these ideas in the first place), the masters could regulate birth and death by fiat. Thus, the population would be stabilized at some rational figure and projects such as Dyson's would never be indicated.

In short, uncontrolled population growth will make the construction of artificial biospheres impossible, and control will make them unnecessary. So astronomical discovery of infrared sources won't prove anything about the inhabitants of other planets.


POUL ANDERSON

*3 Las Palomas Road, Orinda, California*


The suggestion by Freeman J. Dyson for investigating solar far-infrared radiation as one way to detect extraterrestrial intelligence sounds quite practical and sensible.

This leads me to suspect that if Dyson's assumption is correct—that intelligent beings exist of a far higher order of technological achievement than our own—it would be well-nigh impossible for such beings *not* to have detected us.


EUGENE A. SLOANE

*"Air Engineering," Detroit, Michigan*


In reply to Maddox, Anderson, and Sloane, I would like only to add the following points, which were omitted from my earlier communication.

1) A solid shell or ring surrounding a star is mechanically impossible. The form of "biosphere" which I envisaged consists of a loose collection or swarm of objects traveling on independent orbits around the star. The size and shape of the individual objects would be chosen to suit the convenience of the inhabitants. I did not indulge in speculations concerning the constructional details of the biosphere, since the ex-

pected emission of infrared radiation is independent of such details.

2) It is a question of taste whether one believes that a stabilization of population and industry is more likely to occur close to the Malthusian limit or far below that limit. My personal belief is that only a rigid "police state" would be likely to stablize itself far below the Malthusian limit. I consider that an open society would be likely to expand by a proliferation of "city-states" each pursuing an independent orbit in space. Such an expansion need not be planned or dictatorially imposed; unless it were forcibly stopped it would result in the gradual emergence of an artificial biosphere of the kind I have suggested. This argument is admittedly anthropomorphic, and I present it in full knowledge that the concepts of "police state" and "open society" are probably meaningless outside our own species.

3) The discovery of an intense point source of infrared radiation would not by itself imply that extraterrestrial intelligence had been found. On the contrary, one of the strongest reasons for conducting a search for such sources is that many new types of natural astronomical objects might be discovered.

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## Hazards and Insecticides

Philip R. White states [*Science* **131**, 614 (26 Feb. 1960)] that "the problem" is much wider than "poisoned cranberries," chickens, and so on; that "the problem" is a "premature or inadequately prepared commercialization of scientific finding." White fortifies his opinion with a few cases, stating that these must be only a few of hundreds. White has presented only one side of the coin. That certain cases do represent a very dangerous trend is true, but the reverse side of the coin may be equally dangerous.

Pray let me, like White, cite a few examples. In the last few years this laboratory has tested two chemicals that came to us from Europe, highly recommended. In both cases we found the materials ineffective although not in any way dangerous. One of these was already on the market in Europe but was withdrawn because our work proved it ineffective. This case parallels the case of the French weed killers cited by White.

In the 1930's *Anopheles gambiae* was rampant in the valley of Rio Grande do Norte in northeastern Brazil. Many scientists (altogether too many) stated dogmatically that it was impossible to eradicate these mosquitoes, that the misery, sickness, social disorders, and death visited upon Rio Grande do Norte were inevitable for the Western Hemisphere from Buenos Aires to Galveston. Fortunately a small group of scientists supported by the Rockefeller Foundation and the Brazilian Government staked their honor and reputations, but not their lives, in a scientific Thermopylae. They used the tools available—namely, pyrethrum of evanescent efficacy and paris green of extremely high toxicity. In 2 years morbidity cases among the field workers numbered 595. Compare this with statistics for the village of Caicó (some 600 inhabitants), where there were 64 fatalities in the month of May 1959 as a direct result of invasion by *Anopheles gambiae*. *Anopheles gambiae* was eradicated in the Western Hemisphere, although the only weapons available were ineffective or hazardous by present scientific standards. The incident is forgotten, although it has been fully published and the report is readily available for anyone's perusal [F. L. Soper and B. Wilson, *Anopheles gambiae in Brazil* (Rockefeller Foundation)].

Today in the northeastern United States the dairy industry is confronted

with a new and dangerous pest—namely, *Musca autumnalis* or face fly. This insect is very closely related to the house fly, but it differs in habits. It congregates on the face of cattle, and these miserable animals have no defense. Like its close relative the house fly, it is an extremely effective transmitter of certain disease organisms, such as staphylococci, salmonellae, coliforms, and other enteric bacteria. It even likes the face of man, particularly the corners of the lips. For two summers I have watched this pest on the cattle pastured almost in my back yard. They are miserable animals with sore eyes, and I do not for one minute suppose that their milk is of the highest or most nutritious quality. We have available insecticides which are safe by any reasonable standards, and effective. However, they may not be used legally on dairy cattle because of the fanatical attitude of certain federal officials. The face fly is spreading steadily in the northeastern United States, where nothing is done to control or to eliminate this disease-bearing pest. I wish to point out that this is a very dangerous trend. We are accepting an obvious and well-proved hazard because certain individuals with legal power dream of a possible hazard connected with the use of insecticides upon dairy cattle. We grant that certain insecticides can be dangerous, but there are available today effective drugs that are not hazardous from the scientific point of view. They have been very well studied, and while they cannot be declared absolutely innocent (the absolute has no place in science) they are, when used as insecticides, as innocent as sugar, salt, or milk itself. This is all that a relative science can do, for science can never be absolute.

White's complaint, that insecticides used to control the fire ant are hazardous to wildlife, is out of proper reference. If permitted to spread throughout the southern United States, this pest species will destroy many wild species and their habitats. D. Hey, writing of Cape Providence, Union of South Africa, states, "particularly introduced forms such as the Argentine Ant" have played their part in depletion of wildlife. Evidence of the same "depletion" is recorded for the United States. We should not trade temporary loss of a few species over a small area for permanent loss of many types over a much larger area.

As Francis Bacon stated years ago, we must be willing to accept new remedies, or we must prepare ourselves for new ills. The fire ant and the face fly are merely two of the many ills that presently affect us. I know of many more. They happen to be new to this part of the world, but there are old as well as new problems. These are scientific problems and they must be dealt with by scientific methods. This means that we must open our minds to the relative laws of science and bar therefrom the absolute nonsense that has created the cranberry scandal and is driving us toward a dairy debacle. Every new drug should be adequately tested by the relative laws of science in general and of biology in particular. The use of absolute dicta, of the philosophical zero, such as White seems to approve, will prove disastrous again as in the past. Science can never prove absolute safety—it can prove necessity and relative safety.

Generalization from such limited cases is of uncertain value; the conclusion that the problem is fundamentally biological seems unavoidable. Consequently, the solution must follow the laws of biological science. The virulent poisons produced by staphylococci and other pathogens are a part of the problem. Dogmatic regulations that contravene the laws of biology will prove dangerous and even disastrous. Safety must be defined in terms of biology and not in terms of a philosophical zero, an absolute mathematical formula, or an analytical procedure.

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## Electronic Brains?

A few years ago the new electronic digital computing machines were often popularly referred to as electronic brains. However, this practice soon fell into disrepute among scientists and engineers. A cliché which developed said in effect, "A general-purpose digital computer is designed to carry out arith-

metic operations in a predetermined sequence and could never think in any sense of the word." This cliché still represents the dominant attitude of many scientific and engineering publications on both sides of the iron curtain. An elaboration, which often follows the cliché, explains that the sequence of arithmetic and logical operations is completely predetermined by a human programmer, and any appearance of thinking by the computer is merely a manifestation of the thinking of the human programmer. (The general-purpose digital computers do carry out sequences of arithmetic and logical operations as specified by the programmer, but the programmer may specify that the sequence shall vary as a function of the input variable [or sensory] data.)

These projections of their own ignorance by pseudo experts may be amusing to researchers who are daily engaged in mechanized-thinking experiments on general-purpose and special-purpose computers. However, a scientist seeking employment or approval for a new project from a director of a research laboratory may not find these negativistic attitudes at all amusing. Such negativistic statements are almost invariably followed by a challenge to demonstrate the mechanized-thinking process by deriving the general theory of relativity. This seems comparable to requiring the Wright brothers to prove that they could fly by flying nonstop around the world.

It may seem improbable that research directors would be so ill informed concerning subjects relevant to their work. However, this seems to be the rule rather than the exception. It would appear that prominent scientists and engineers should be more cautious about asserting that certain things cannot be done merely because they do not know, at the moment, of any feasible method. They not only leave themselves open to ridicule in many instances but may also hinder the progress of research, for the direction of scientific research may be greatly affected by a simple, negativistic, dogmatic, cliché.

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## Conversions

Apropos the editorial on "Metric versus English units" [*Science* **131**, 195 (22 Jan. 1960)] with its implications regarding conversions, I should like to call your attention to the reports on the Tiros [*Science* **131**, 1031 (8 Apr. 1960)] and U.S.S.R. "space ship" [*Science* **131**, 1510 (20 May 1960)] satellite launchings.

Apogee and perigee of the Tiros are given as 407.2 and 378.7 nautical miles, respectively. According to my conversion tables, 1 nautical mile equals 1.1516 statute miles. The corresponding apogee and perigee should be 468.9 and 436.1 statute miles. In the article they are given as 468.28 and 435.5 statute miles, corresponding to a conversion factor of 1.1500 statute miles per nautical mile.

Similarly, the announced weight of the Russian "space ship" was 4 tons, 540 kg. In the *Science* article this is given as 9988 pounds, corresponding to a conversion factor of 2.2000 lb/kg. In fact, the conversion is 2.2046; the weight in English units is apparently 10,009 lb.

For the purposes of the articles in *Science*, accuracy in these details is probably not important. Nevertheless, there is a lesson to be learned about the simplicity of conversions within the metric system and about the retention of significant figures during and after conversions.

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