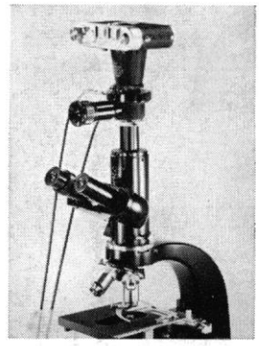
SCIENCE

18 March 1960

Vol. 131, No. 3403

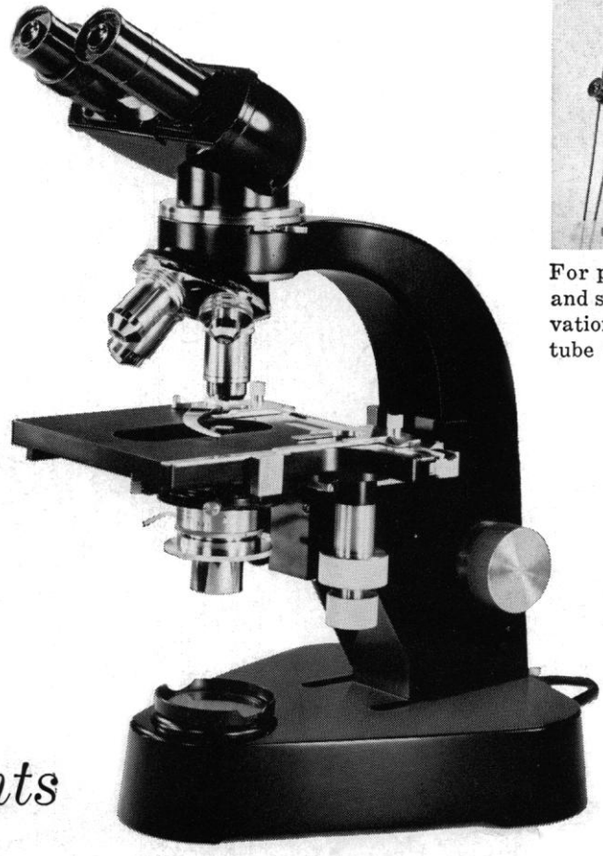
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Gordon Research Conferences



For photomicrography and simultaneous observation, binocular photo tube "FS" is available

the laboratory microscope which fulfills research requirements



the new LEITZ LABOLUX IIIa

The Leitz Labolux IIIa is a new laboratory microscope with built-in illumination and the famous Labolux ball-bearing focusing control, which combines both coarse and fine focusing in a single knob. Available with a wide variety of accessories, the Labolux IIIa is recommended for all routine laboratory work and, in addition, can be equipped to fulfill the most exacting research.

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• inclined binocular tube S with knurled knob to adjust for proper interpupillary distance • built-in mechanical stage #25 • two-lens condenser #95 • substage unit with rack and pinion focusing accepts sleeve-type condensers • quadruple nosepiece with achromats 3.5X, 10X, 45X and 100X oil immersion, the last two having spring-loaded mounts • paired 10X wide-field eyepieces • horizontal carrying case • 3-step transformer, 6 V., 2.5 Amp.

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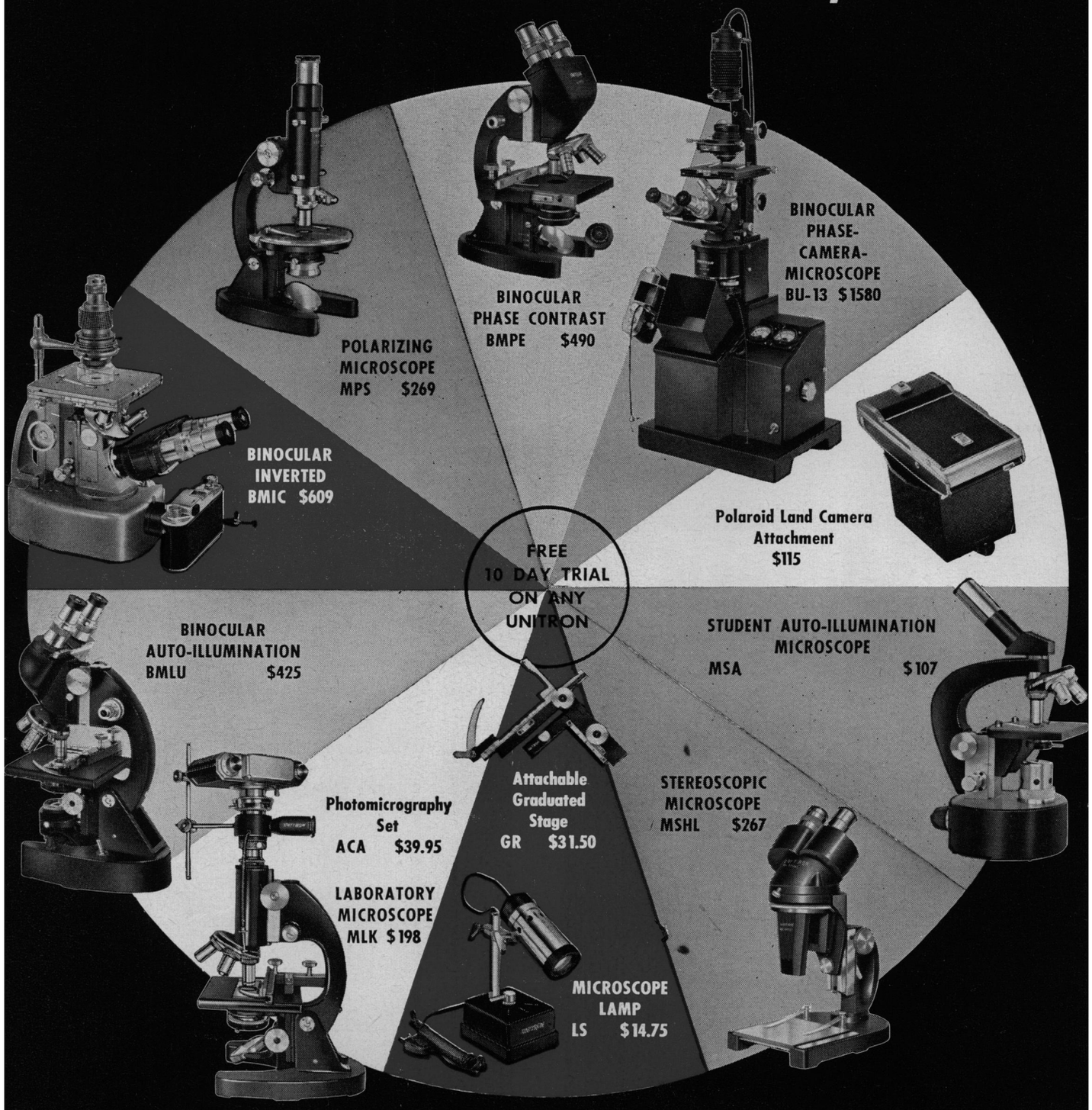

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18 March 1960, Volume 131, Number 3403

SCIENCE

Cover

Aurora, taken at the Ballaines Lake field station of the Geophysical Institute, University of Alaska, in mid-April 1957. The structures in silhouette are dipoles of the institute's radio telescope. Exposure, 5 seconds. [V. P. Hessler]

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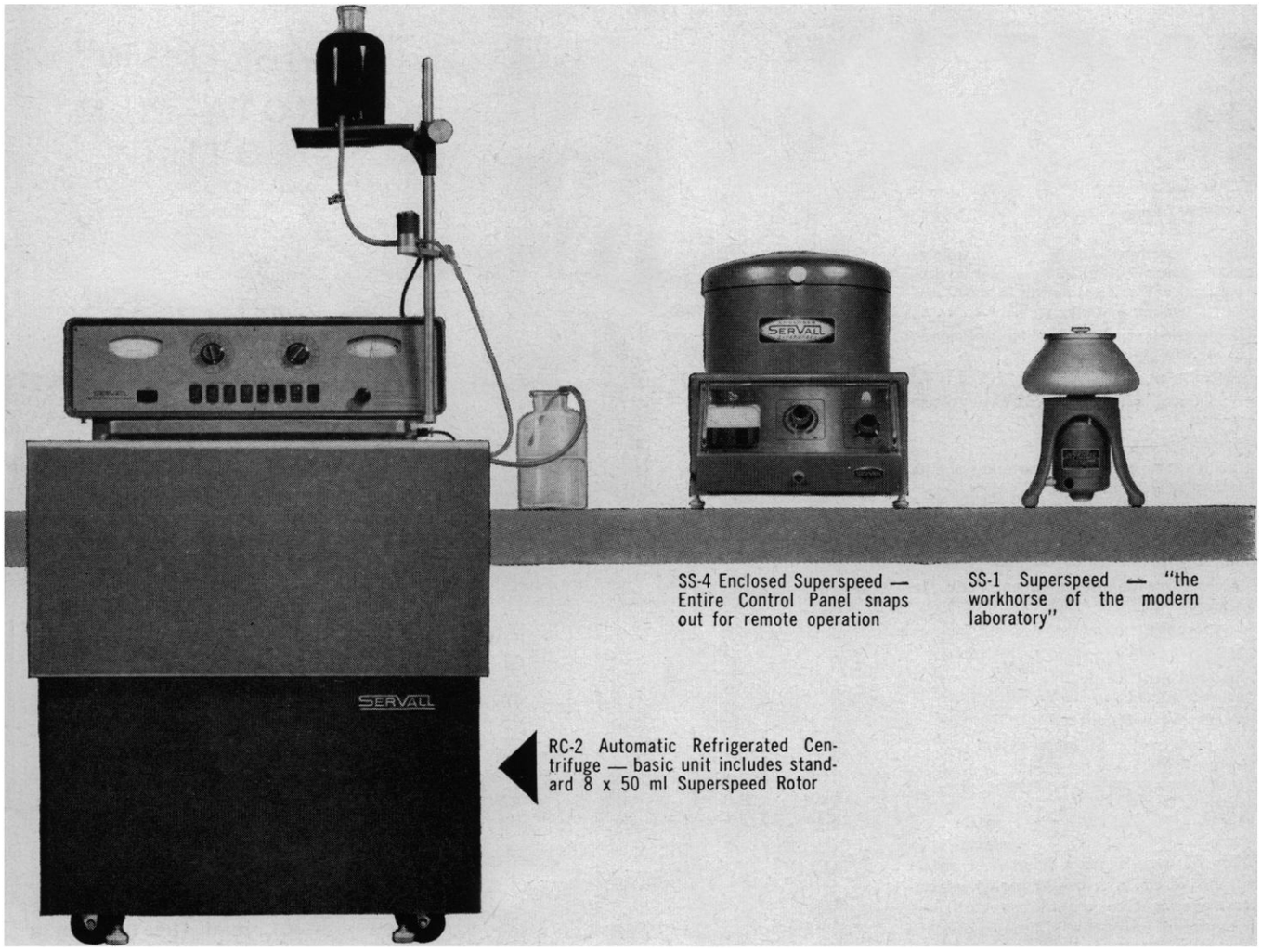

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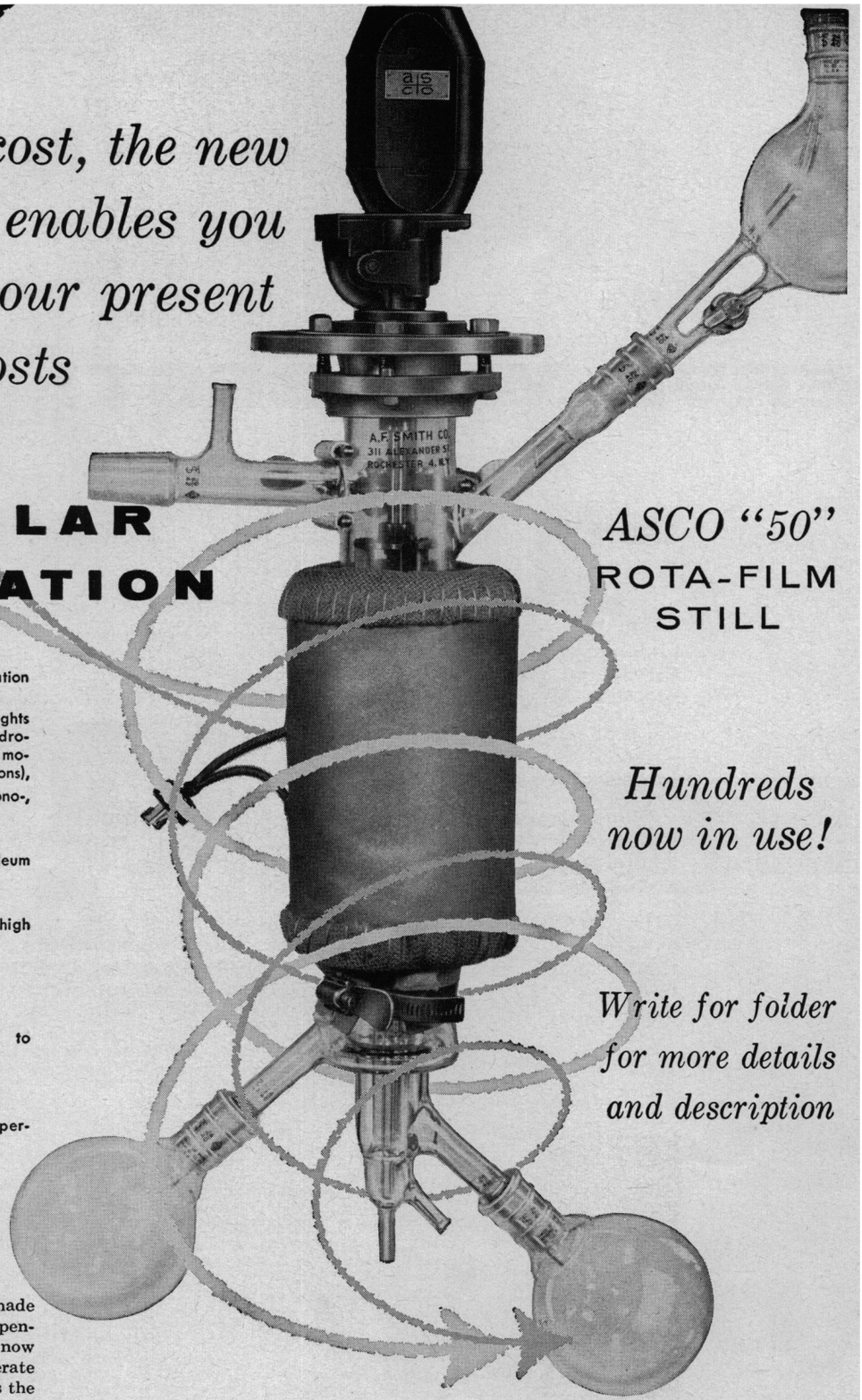

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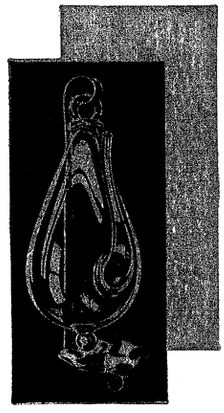

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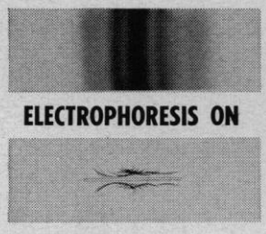
- Each Microfix frame separately boxed.
- Microfix equipment includes frames, with and without hooks, covered racks, file cabinets, clip-on metal indexing tabs, etc.

BULLETIN 262

MICRO
IMMUNO



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- Designed for use with standard microscope slides.
- Eight patterns obtained in a single run with one cell, 24 with three cells on same power supply.
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BULLETIN 257

THE PROCESS

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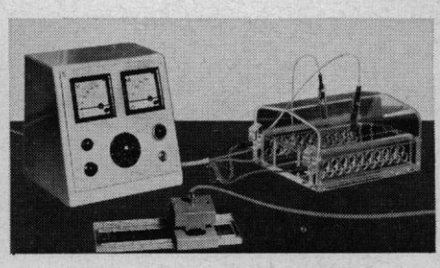
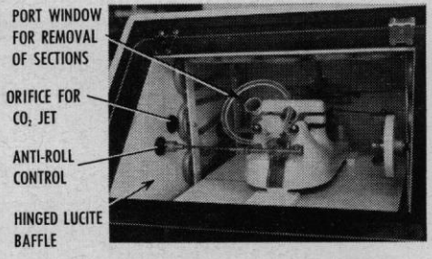
- Immunological reactions observable immediately following electrophoresis.
- Pattern may be inspected and photographed throughout processing.



CRYOSTAT



From fresh tissue to mounted stained sections in 10 minutes

FEATURES

- Cuts sections down to 4 microns.
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BULLETIN 259

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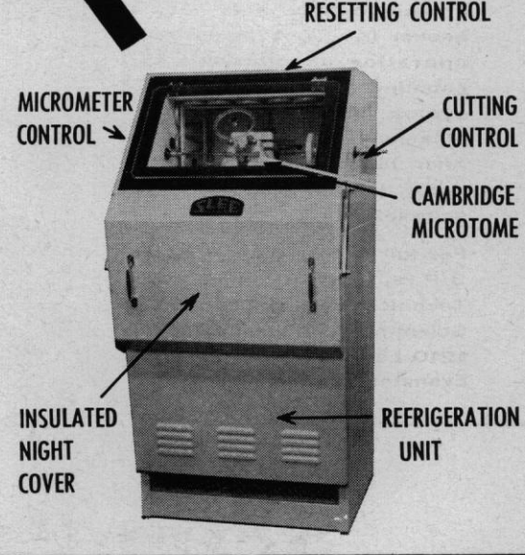

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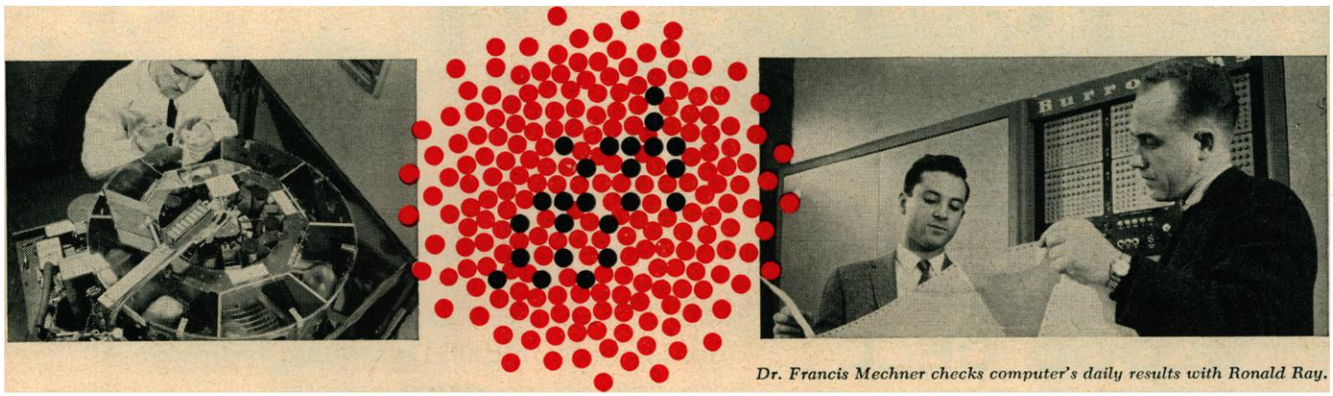
"In behavioral research alone, our Burroughs computer has multiplied our productivity by 100 times!"



Dr. Francis Mechner checks computer's daily results with Ronald Ray.

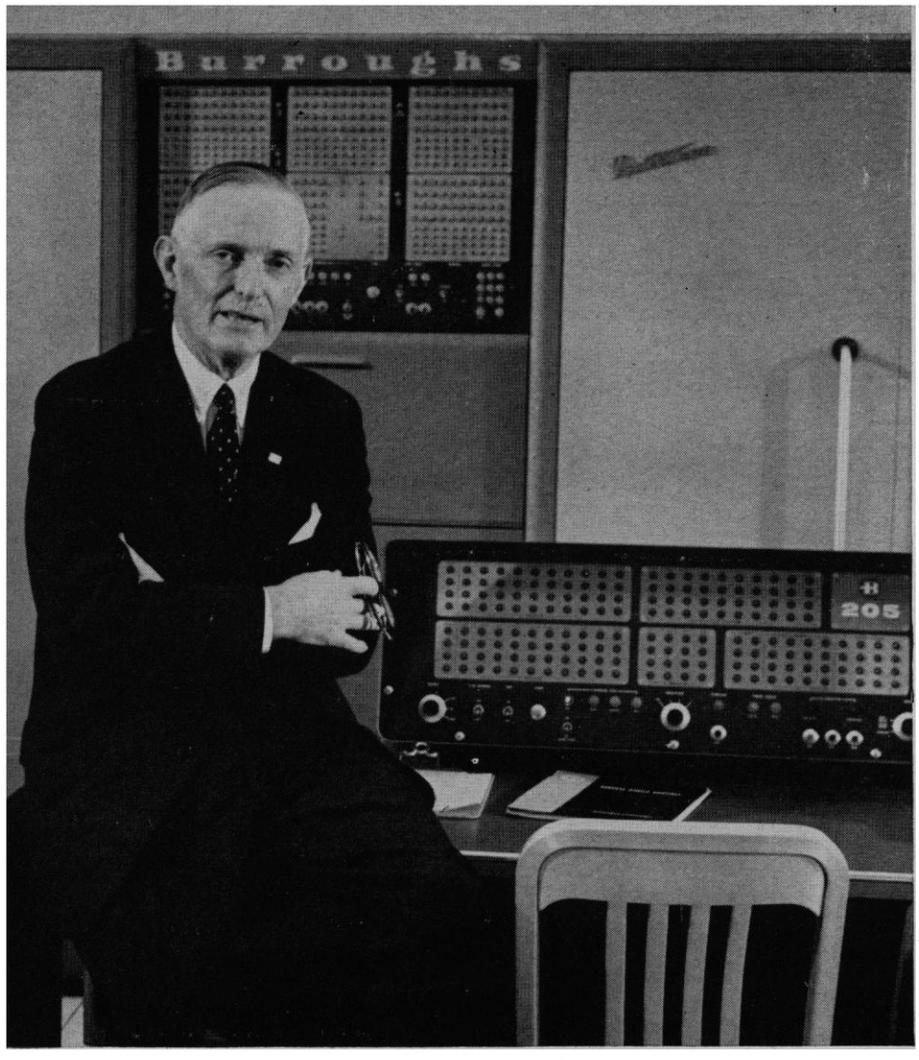
"We, at Schering Corporation, have grown accustomed to miraculous developments in our industry. So many advancements have been made in pharmaceutical research in the last two decades, we are convinced that we may indeed be on the brink of a pharmacological revolution.

"Yet, there is so much more to be done, so many new avenues to explore, that we recognize the only real source of continued development is through expanded research efforts. Through research, Schering has already created several of the world's leading ethical drugs... major emphasis has been on cortical hormones and antahistamines. Some, like Coricidin, have become household words.

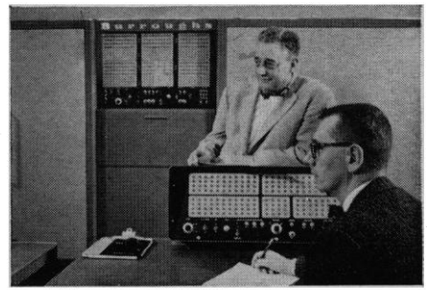
"While the results of research are sometimes dramatic, there is little of the miraculous in the day-to-day explorations made by pharmaceutical scientists. For one thing, pharmaceutical research is expensive... costs are over three times more per sales dollar than all other industries and rising substantially each year. Findings are often inconclusive and only a small portion ever reach fruition in a marketable product. And with a diversified line of products such as ours, we must maintain research projects in many different areas simultaneously. Even with the newest and most successful discovery, a competitor may enter the market with a better product that puts yesterday's 'miracle' out of favor.

"Yet, a relentless search for new products is a necessity. It is the only reasonable assurance of the continuing health of our own business enterprise. Today we are conducting extensive experimentation with chemical molecules of known pharmacological properties. The object is to achieve radically new pharmacological results by means of various alterations in chemical structure. Once achieved, these new compounds must be evaluated in laboratory animals. The methodology of this program is exemplified by an experiment carried out in Schering's Behavorial Research Laboratory. Here, eight highly trained rats take their turn in succession night and day, at a testing station where their behavior is recorded and then analyzed by computer. This is the type of experimentation in which the behavorial effects of drugs are tested in animals. The results of these experiments permit predictions concerning the effects these drugs will have on man.

"With thirteen experiments of this type proceeding on a continuous basis, the volume of data generated could never be handled without the aid of a computer. The Burroughs 205 performs computations every day which the staff



PHOTOGRAPHS BY J. ALEX LANGLEY



Dr. Bradley Whitman, Director of Research Services, confers with Gordon B. Thomas, Biometrics Manager.

of Schering's Behavorial Laboratory would require years to complete. The computer's final output is in the form of tables and graphs which are then studied and interpreted by psychopharmacologists.

"The decision to install a Burroughs 205 computer was upheld by a need to provide rapid, complete and economic analysis of the data which is produced by the research division at great cost. We investigated the computer field thoroughly, and after careful study and professional consultation, our technical people believed no other computer met our requirements so well. One of our scientific programmers, Biometrics Manager Gordon B. Thomas, was particularly impressed with the 205's ability to handle large masses of data with the power of a large scale computer... and at less than half the cost. Mr. Thomas felt the 4000-word memory of the 205 greatly facilitated the execution of research programs, many of which exceed 10,000 steps.

"In our research projects alone, the 205 has earned its keep. Dr. Bradley Whitman, head of Research Services, reports our 205 computer is turning out fast, accurate results at a cost we could never have realized by any other method. Research scientists are freed from time-consuming data collecting and may now spend more time on creative work.

"In addition to serving as a research aid, our 205 has provided us with other benefits as well.

"Our Procedures Department Manager, William B. Spencer, points out that the 205 is completely compatible with our commercial needs as well as research. In fact, our recent purchase of additional Burroughs peripheral equipment will allow us much greater capacity for commercial applications.

"As we expand and broaden our search for new products, we expect commensurate growth in other areas of our company as well, and we are confident that our 205 computer, with its modular expansion features, will keep pace with our computing needs."

FRANCIS C. BROWN
Chairman of the Board and President
Schering Corporation

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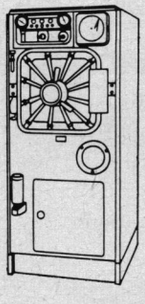

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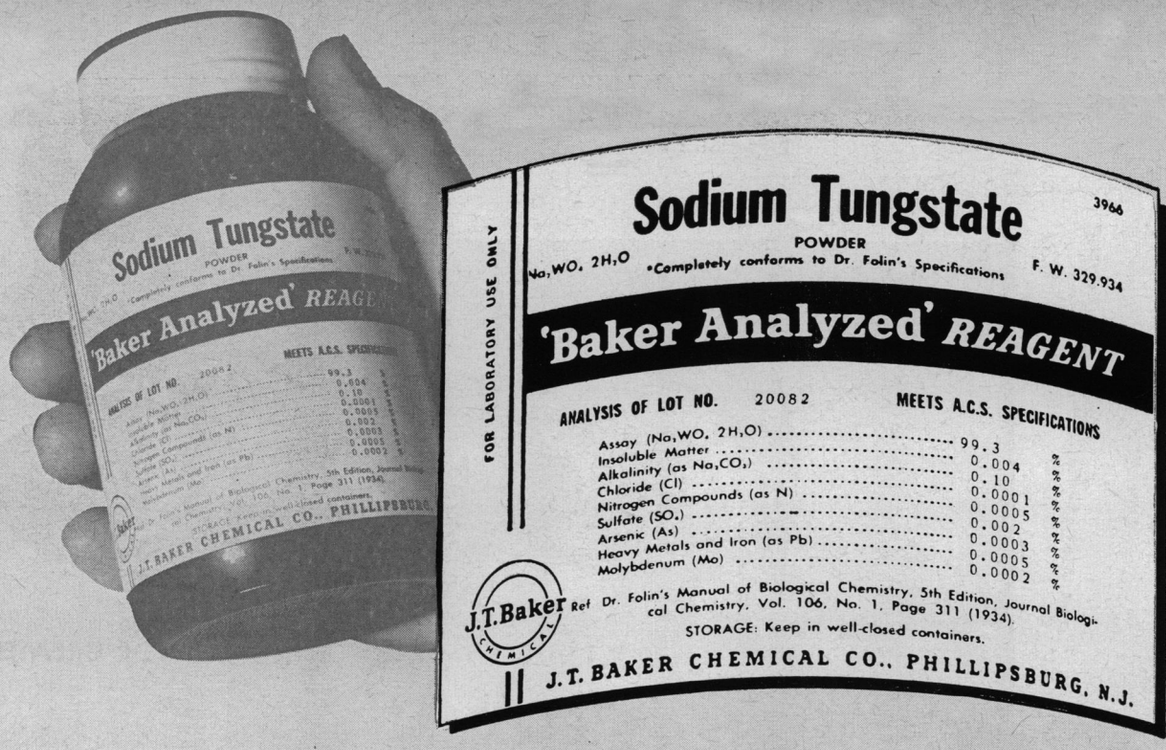

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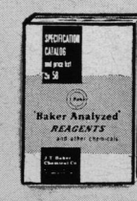

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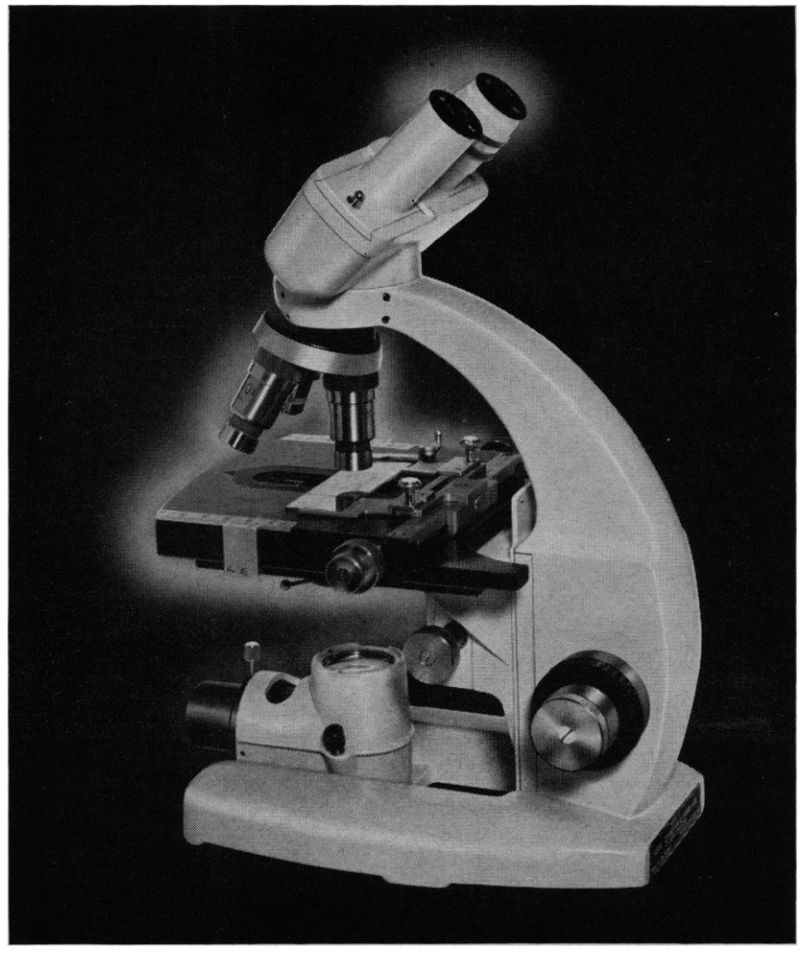

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- Eight different vacuum drums available.
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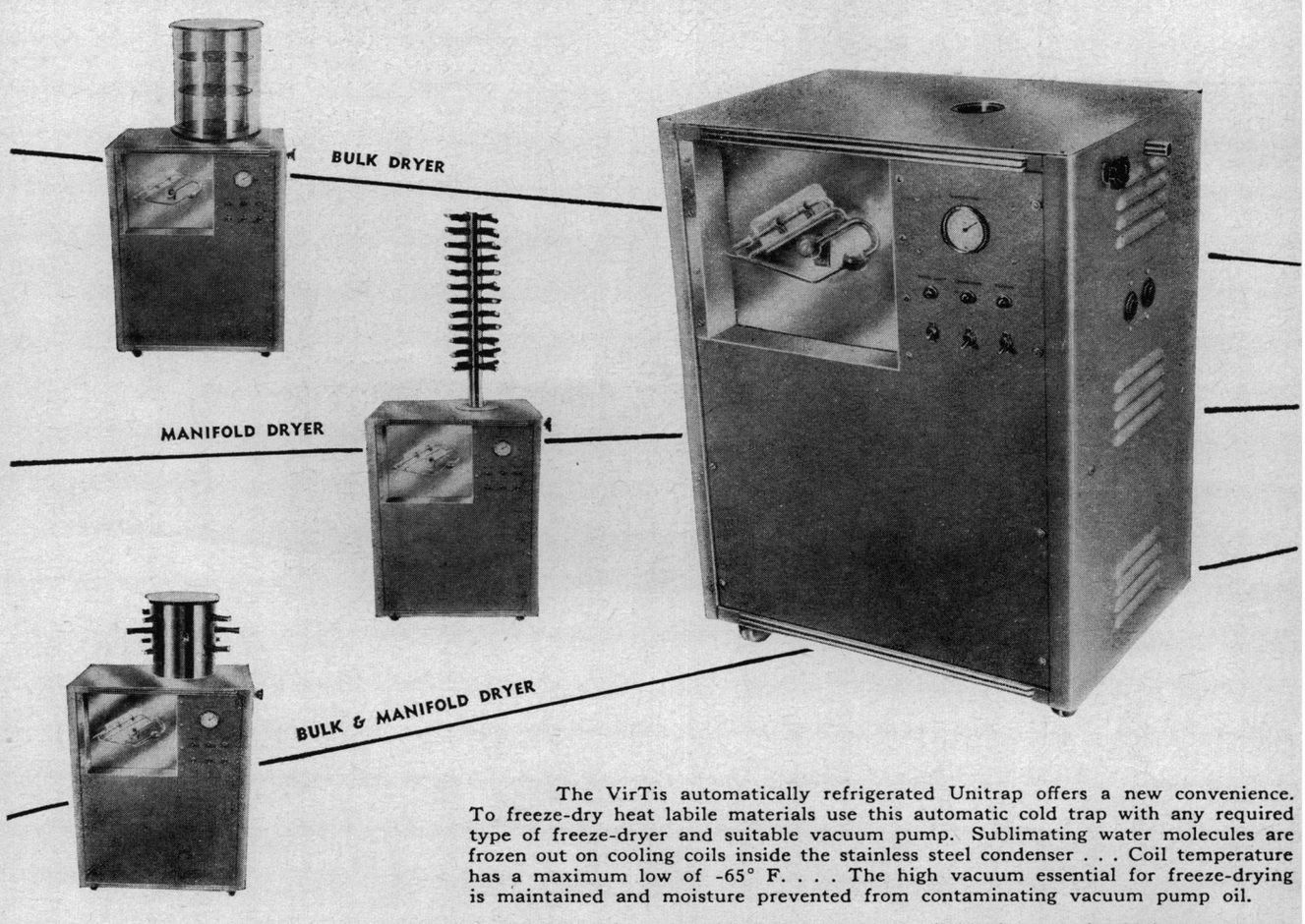

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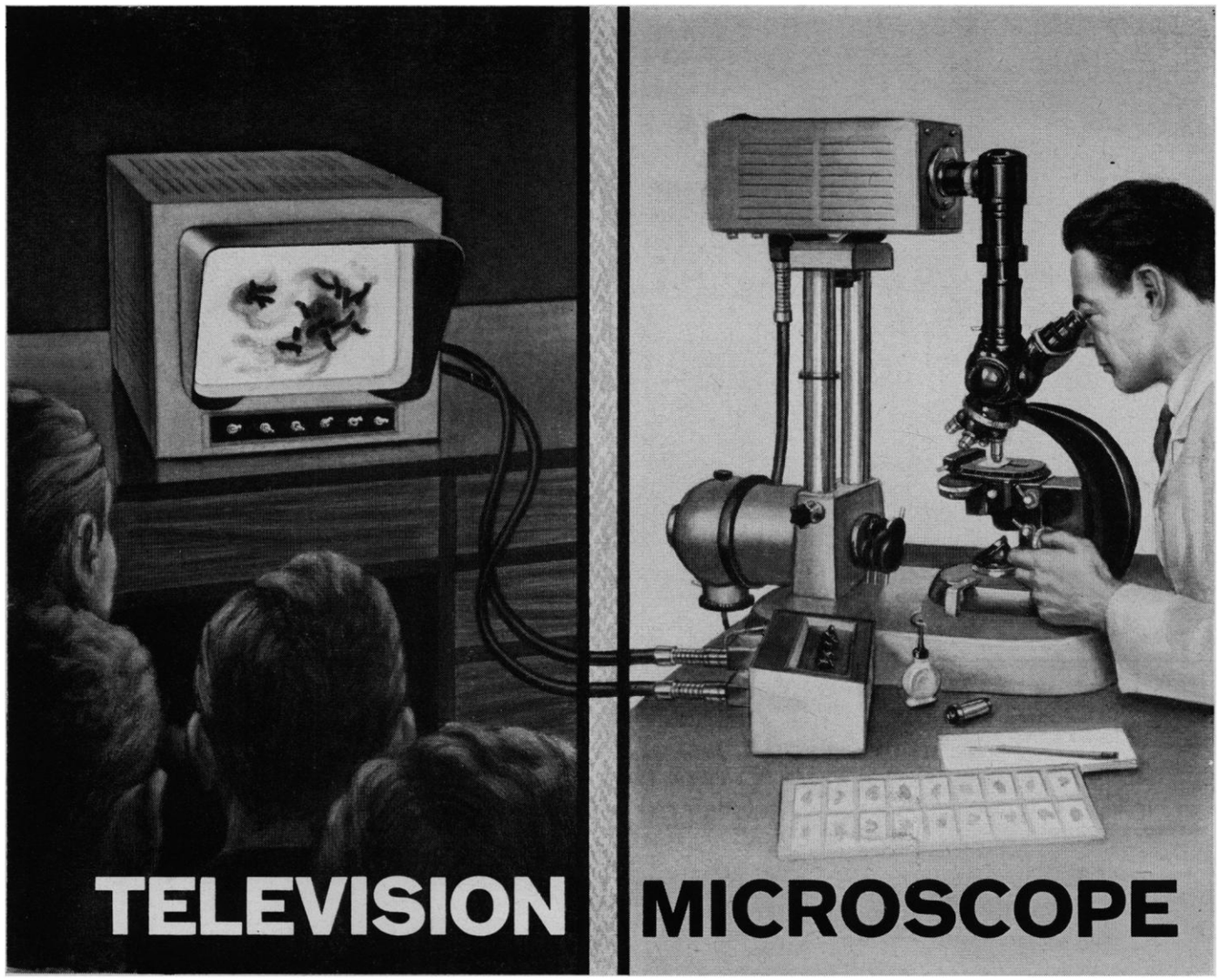

CONSIDER THE APPLICATIONS OF THIS NEW ZEISS-SIEMENS ACHIEVEMENT

The new Zeiss-Siemens Television Microscope is the first integrated closed circuit TV system developed specifically for use with the microscope. It was designed for maximum operator convenience — simplified controls and compact construction.

The optical components are intended for use with the microscope stand WL, but can on demand be adapted for use with other stands such as the Zeiss automatic photomicroscope. All electronic accessories are manufactured by Siemens. The latter are unique in offering unsurpassed resolving power through the use of a scanning system of 625 lines per frame. An automatic gain control maintains a constant level of light intensity on the viewing screens.

We suggest the following applications for the TV microscope:

— Projection of slides at very high magnifications in both brightfield and phase contrast.

— Instructional purposes such as medical school classes.

— Semi-qualitative micro-spectrophotometry.

— Closed circuit systems in hospitals between pathology and operating units.

— Distant observation of material under controlled atmospheres and/or conditions which endanger the observer.

— Microscopy outside of the visible range.

For complete detailed information, request pamphlet 40-380/1-E.

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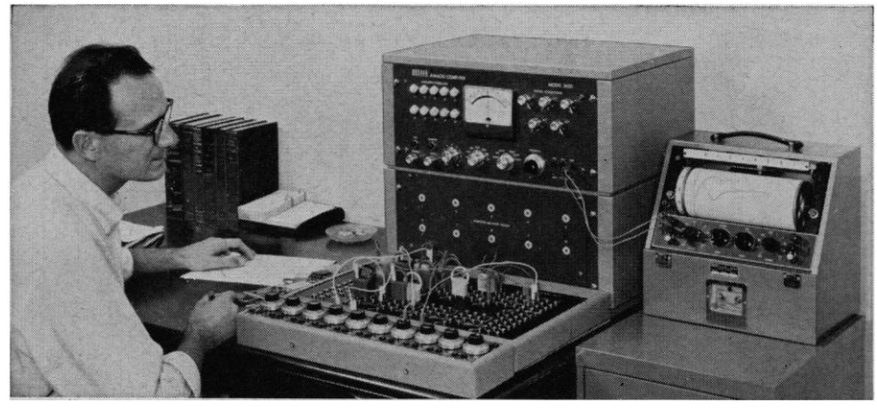
What you should know about Analog Computers

Judging from the literature, most discussion of analog computers turns on form rather than function.

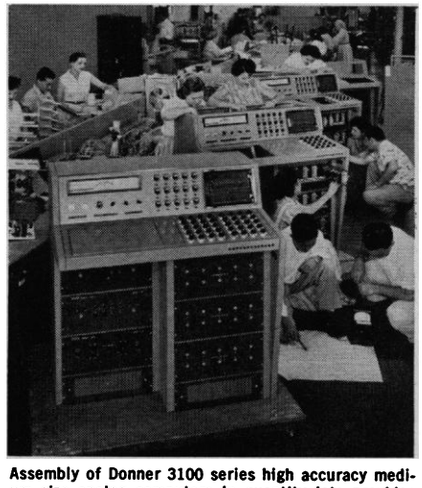
Every computer manufacturer, including Donner, is ready to tell you all about their designs, right down to the last microvolt. Few spend their literary effort in telling you how to use them and what kind of problems are amenable to analog computer solution. Not too strangely, this is what you, the prospective user, wanted to find out in the first place.



The Donner 3400 Desk-top Computer functions as a compact, versatile electrical model of a dynamic system.

HOW AN ELECTRONIC ANALOG COMPUTER SOLVES PROBLEMS

A mathematical expression which defines the dynamic behavior of a particular physical system also describes the behavior of all other analogous systems. A general purpose analog computer can be programmed to behave as one of these analogous systems. So programmed, it can be used to explore the characteristics of the system or to "solve" the describing equations. Typical problems range all the way from explaining the laws of classical and modern physics to the physiological relations of life itself. Here are some of the fields where analog computers are in use: antenna design, medical research, cybernetics, electron trajectories, nuclear reactor design, fluid mechanics, heat transfer analysis, aerodynamics, meteorology, classical and nuclear physics, chemical kinetics, petroleum, engineering, servo system analysis, auto- and cross-correlation, and economic forecasting.



Assembly of Donner 3100 series high accuracy medium size analog computers in quantity lots provides the user with more value at lower cost. Complete Donner 3100 Computer Consoles start at just under $11,000.

Basic computing elements in an electronic analog computer are dc amplifiers, precision components (resistors, capacitors, and potentiometers), and non-linear accessories (multipliers, function generators, and transport delay simulators).

By interconnecting the computing elements at a patchboard, varying voltage amplitudes can be integrated, summed, differentiated, multiplied, divided, altered in non-linear fashion, and otherwise operated on as directed by a mathematical equation. The answer, which appears as a varying voltage, can be visually observed on a voltmeter or an oscilloscope and permanently recorded by any one of several plotting devices.

The analog computer user can take an equation, change the coefficients at will, and get whole sets of solutions with amazing ease and speed. He can get these results to accuracies of 0.1% or better for a very modest investment. Small Donner computers begin at just over $1,000.

ANALOG OR DIGITAL

The chief advantages of the analog technique are speed, economy, and flexibility. With the analog computer, you get a genuine insight into the response of the system to both internal and external stimuli. No other approach can bring the investigator into such intimate contact with the system.

Digital computers sometimes provide more accurate results, but they seldom give the user the same knowledge because they are at best only machines that compound arithmetic information. Unlike digital computers, analog computers actually behave just like the simulated systems.

TWO NEW PUBLICATIONS PROVIDE MORE INFORMATION

If you are interested in learning more about the application of analog computers, copies of Donner Tech Notes #1 and #2 are available from your nearby Donner engineering representative or directly from the factory. Tech Note #1 is titled "How to Simulate a Non-Linear Control System with an Analog Computer;" Tech Note #2, "How to Use and Program Analog Computers."

Donner Scientific specializes in the manufacture of accurate fixed and general purpose analog systems designed to analyze, measure, and control dynamic inputs. Complete technical information and informed applications assistance can be obtained from your nearby Donner engineering representative or writing Dept. 98.

DONNER SCIENTIFIC COMPANY

888 Galindo • CONCORD, CALIFORNIA
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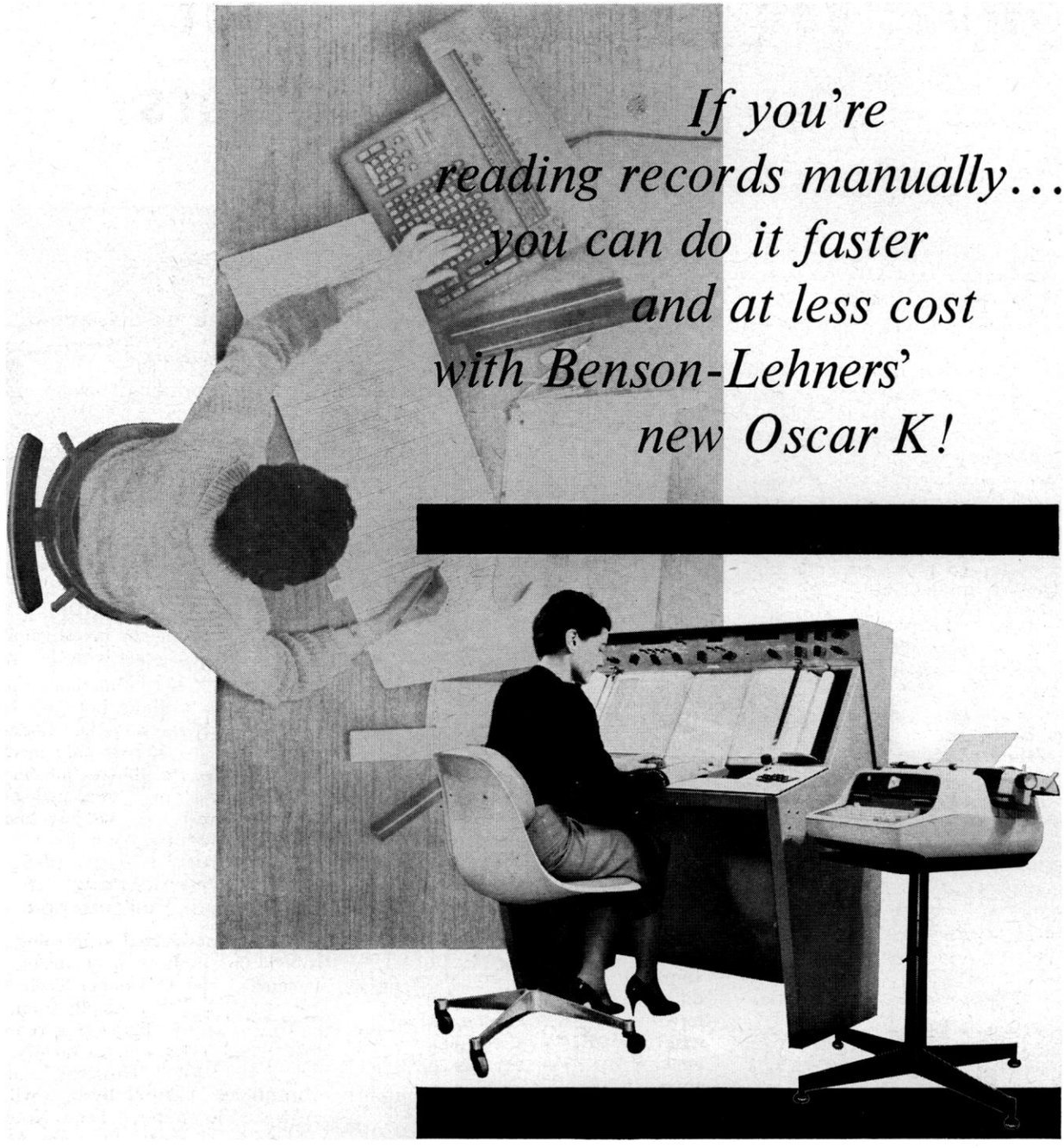

Is your laboratory or test facility getting tangled in a needless time effort in slowly reading, interpreting and transcribing trace records by hand? Here's the answer to your oscillogram and strip chart reading needs; The OSCAR K. *OSCAR K is small;* and in a single console. *OSCAR K is versatile;* it measures trace amplitudes of various sizes and materials – transports records in either direction at variable speeds. *OSCAR K is accurate;* + or — 0.1% of full scale. *OSCAR K is economical;* $4,990! Find out how much the OSCAR K can save your lab in time and money. Write for complete information.

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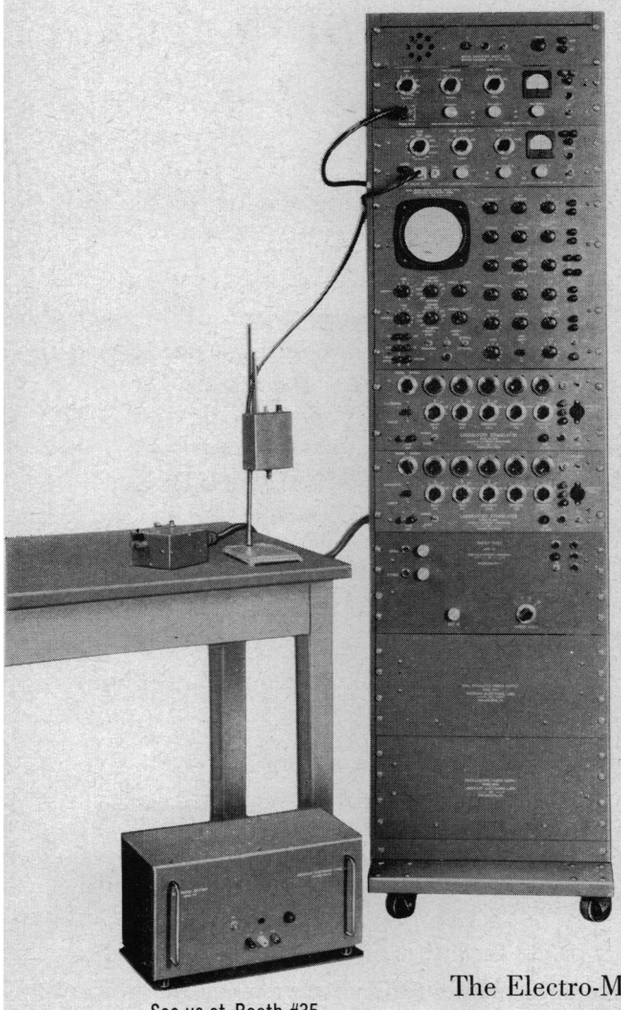

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THE Mettler PAGE

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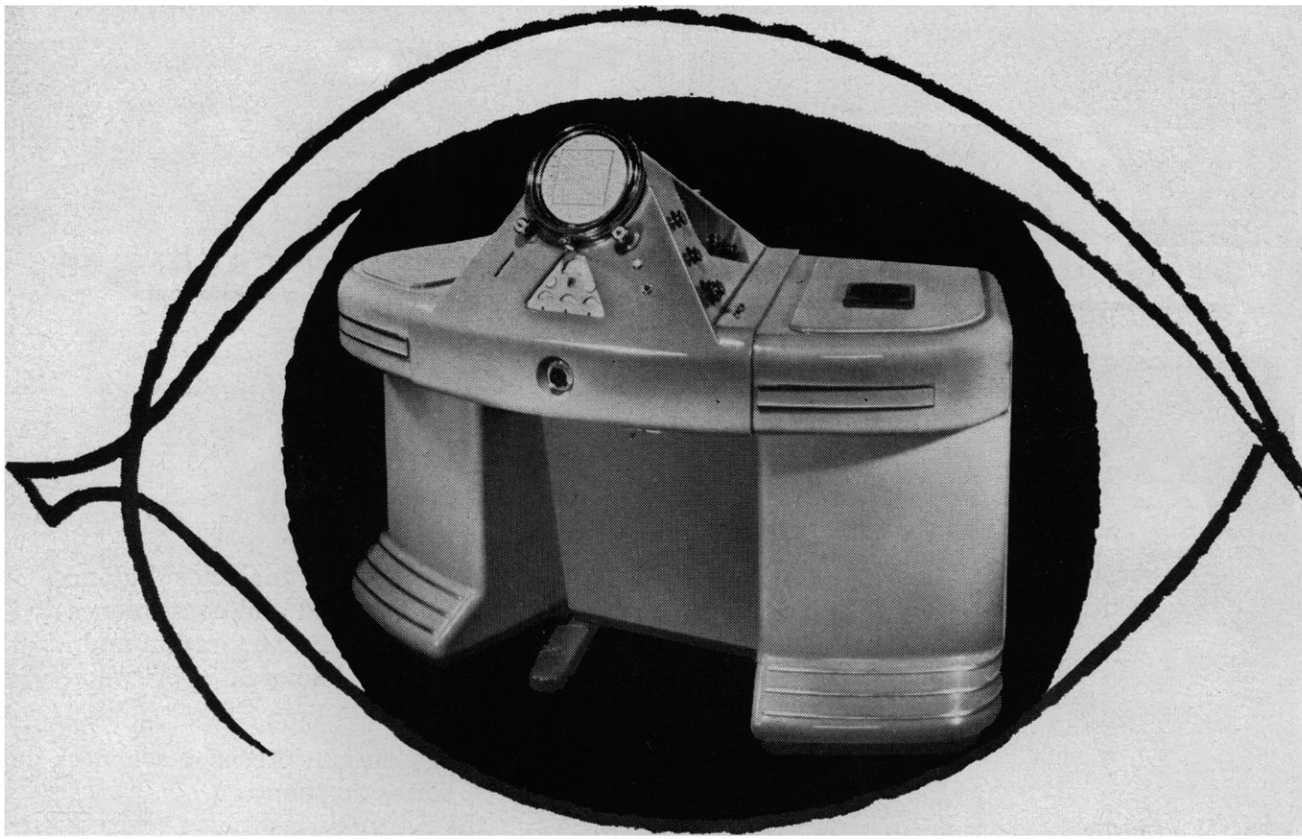

NORELCO ELECTRON MICROSCOPE 100B

In electron microscopy these Philips features constitute obvious design benefits. A new advance in illuminating system offers a coherent electron source. This source maintains the same excellent image resolution found in earlier models, but now provides a noteworthy increase in the relative contrast in the images of thin, frail specimens, whose inherent density variations are not pronounced.

Selective penetration offered by 40, 60, 80 or 100 kilovolts provides a choice by which adequate attenuation of the specimen can be achieved. Another prime feature is the design of the immersion objective lens which provides an unusual facility whereby many desirable physical treatments of the specimen may be made. These include stretching, cooling and heating. It further permits the introduction of air sensitive hygroscopic materials. Another feature, for example, is the ease of obtaining true-stereo images by simple rotation of the specimen in its own plane.

"Work-horse" characteristics offer greatly minimized downtime and maintenance. Inherent resolution in the EM-100B becomes more meaningful with this new increase in relative contrast. Added to this is the convenience, ease and simplicity of operating the EM-100B; low comparative investment costs; and the exclusive basic design feature which precludes obsolescence since all design modifications and improvements can be added to existing models.

Become convinced that the EM-100B Electron Microscope is unexcelled by any other in the market.

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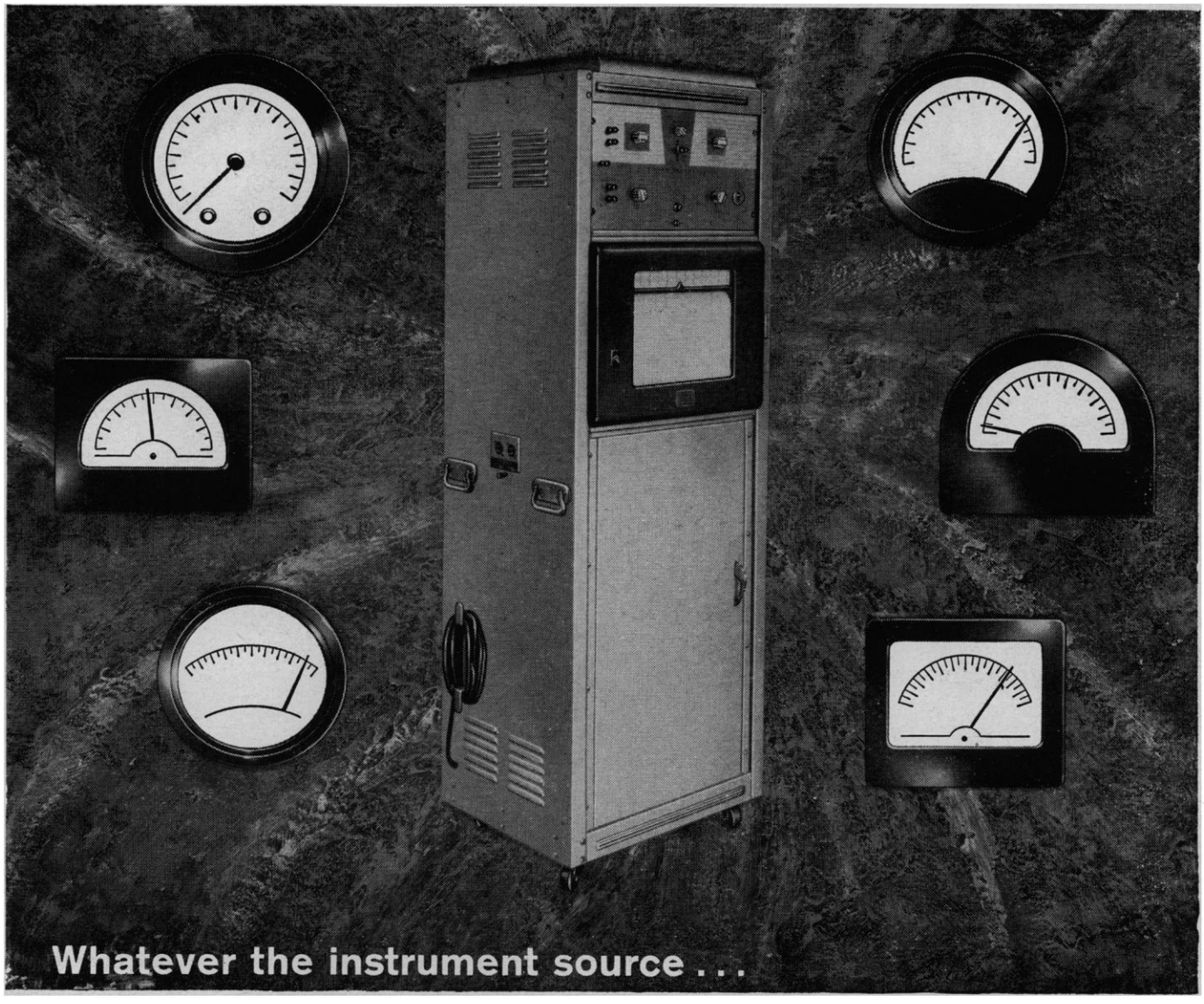
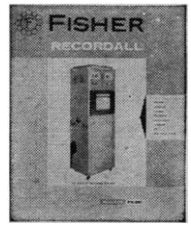


if the reading is convertible into a d-c signal

RECORDALL WILL CHART IT!

Although industry uses a great number of special recording instruments to collect data, the average laboratory cannot afford such duplication. To meet the need, the Fisher Recordall® was developed—the first universal laboratory recorder on the market. The Recordall will chart, as a function of time, *any* instrument reading that can be converted into a d-c signal. It records potential, current, resistance and temperature directly. Transducers are available to enable it to record pressure and vacuum, plot pH changes or draw a polarographic curve.

Direct reading scales, 11 current and potential ranges, wide variety of adapters and accessories . . . these are only a few of the features that make the Fisher Recordall one of the laboratory's most useful and flexible tools.



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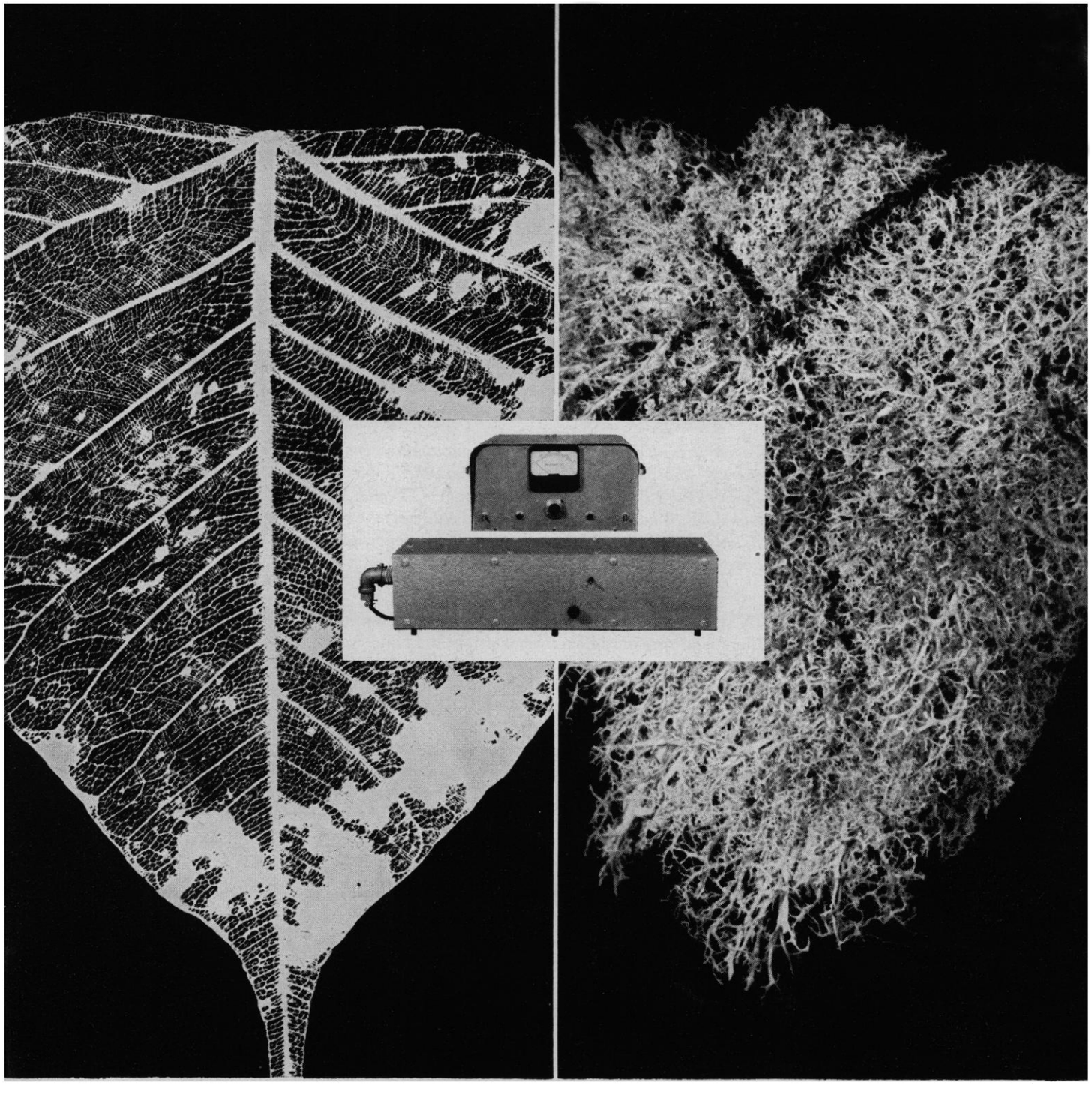

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- Titrate to any preset end point.
- Record first and second derivative titration curve.
- Automatic titration in aqueous or non-aqueous media:
  Acid-base reactions —
  Oxidation-reduction reactions —
  Precipitation reactions —
  Complex-ion reactions —
- Kinetic analysis with permanent record of reaction rate.
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FEATURES

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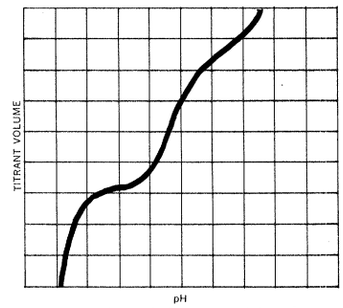
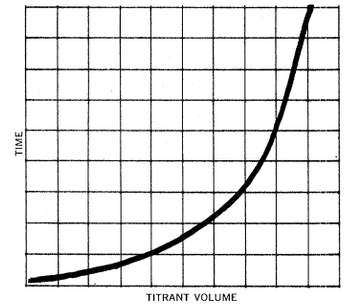
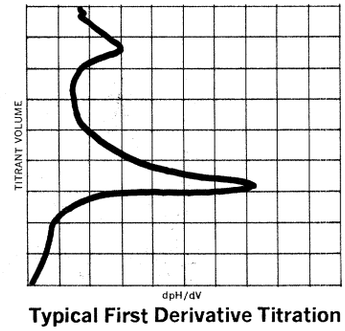
Now, tedious potentiometric titrations that required time-consuming point-by-point analysis can be done automatically. The new Model AT-2A Automatic Recording Titrator makes variable and constant pH titrations automatically, simultaneously providing a permanent record. This new instrument will free chemists for more productive analyses as it speeds routine but difficult measurements.



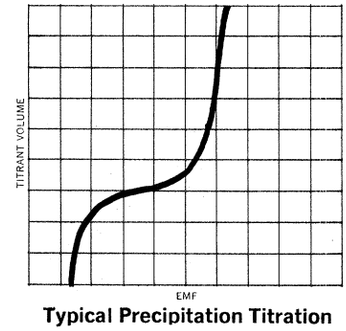
Typical Variable pH Titration



Typical Constant pH Titration



Typical First Derivative Titration



Typical Precipitation Titration

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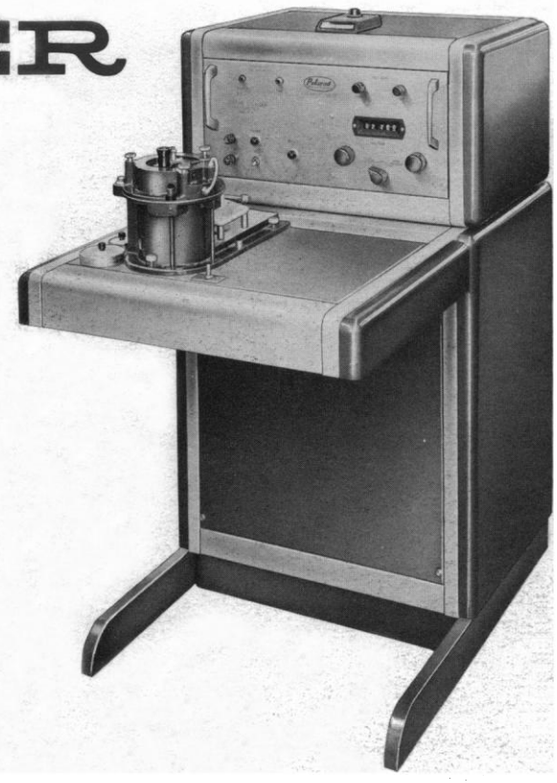

- Molecular weight characterization by intrinsic viscosity
- Kinetic analysis of enzyme systems
- Analysis of polymerization rates

FEATURES

- Extremely low shear rate (0.2 sec^{-1}) virtually eliminates extrapolation to zero.
- Coaxial cylinders combine uniform distribution of shear rate with convenient sample changing.
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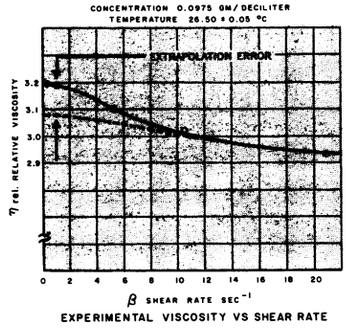
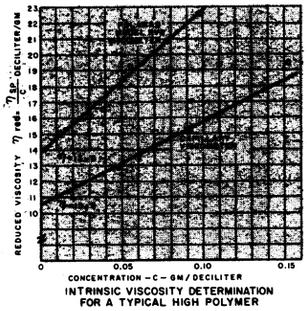
- Temperature of sample maintained to within ±.05°C.
- Cylinder and float constructed from non-corrosive and non-contaminating material.
- The density of the liquid has no effect on the viscosity measurement.



EXPERIMENTAL VISCOSITY VS SHEAR RATE

Viscosity vs. Shear Rate

Analysis of Viscosity vs. Shear Rate for a water soluble high polymer demonstrates the effectiveness of this viscometer in measurement of 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 measurement on the plateau approaching this value.

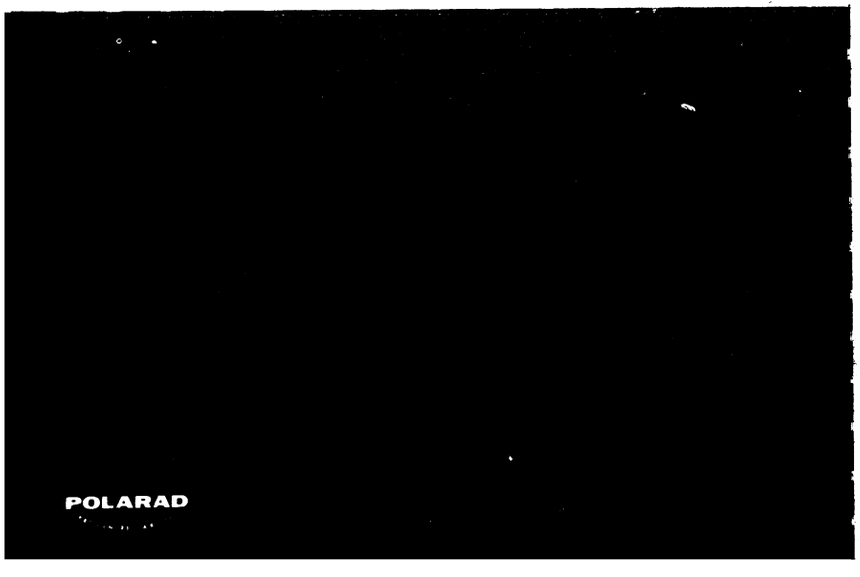


INTRINSIC VISCOSITY DETERMINATION FOR A TYPICAL HIGH POLYMER

Intrinsic Viscosity Determination for a Typical High Polymer

Here reduced viscosity $\frac{\eta SP}{C}$ is extrapolated to zero concentration to obtain intrinsic viscosity $[\eta]$ β=O. C=O.

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 nonuniform shear rate implicit in the capillary method.



Specifications:

Shear Stress Range: 0.002 dyne/cm² to 1.6 dyne/cm².

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.

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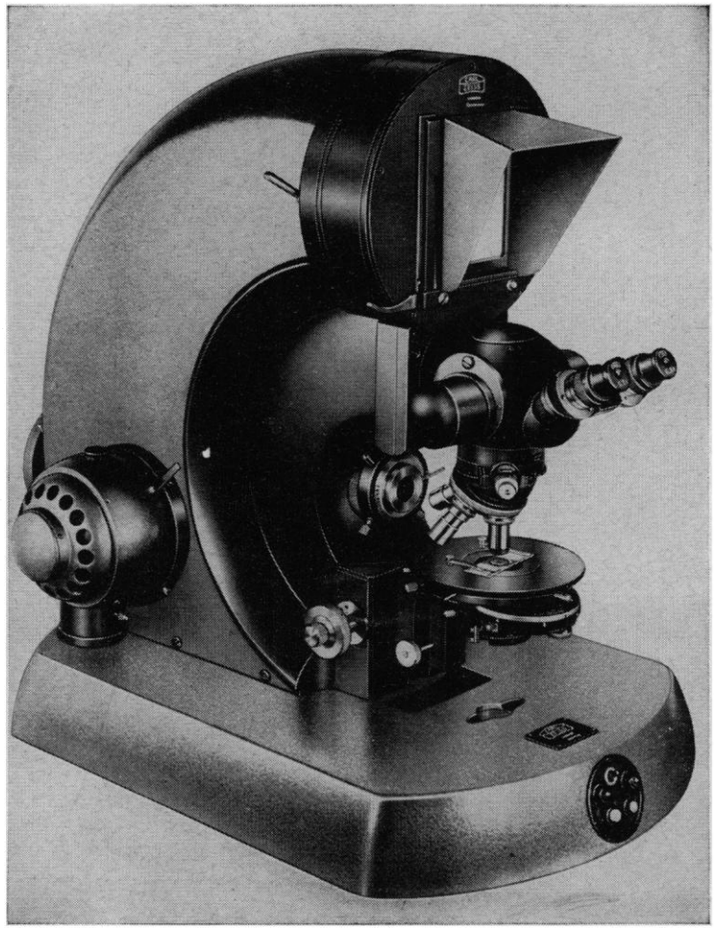

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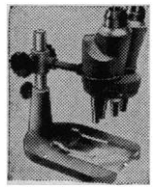

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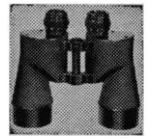

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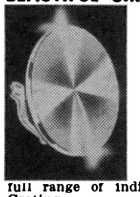

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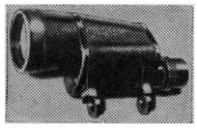

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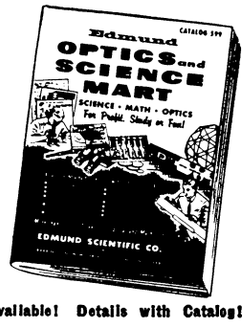

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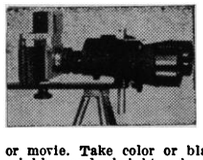

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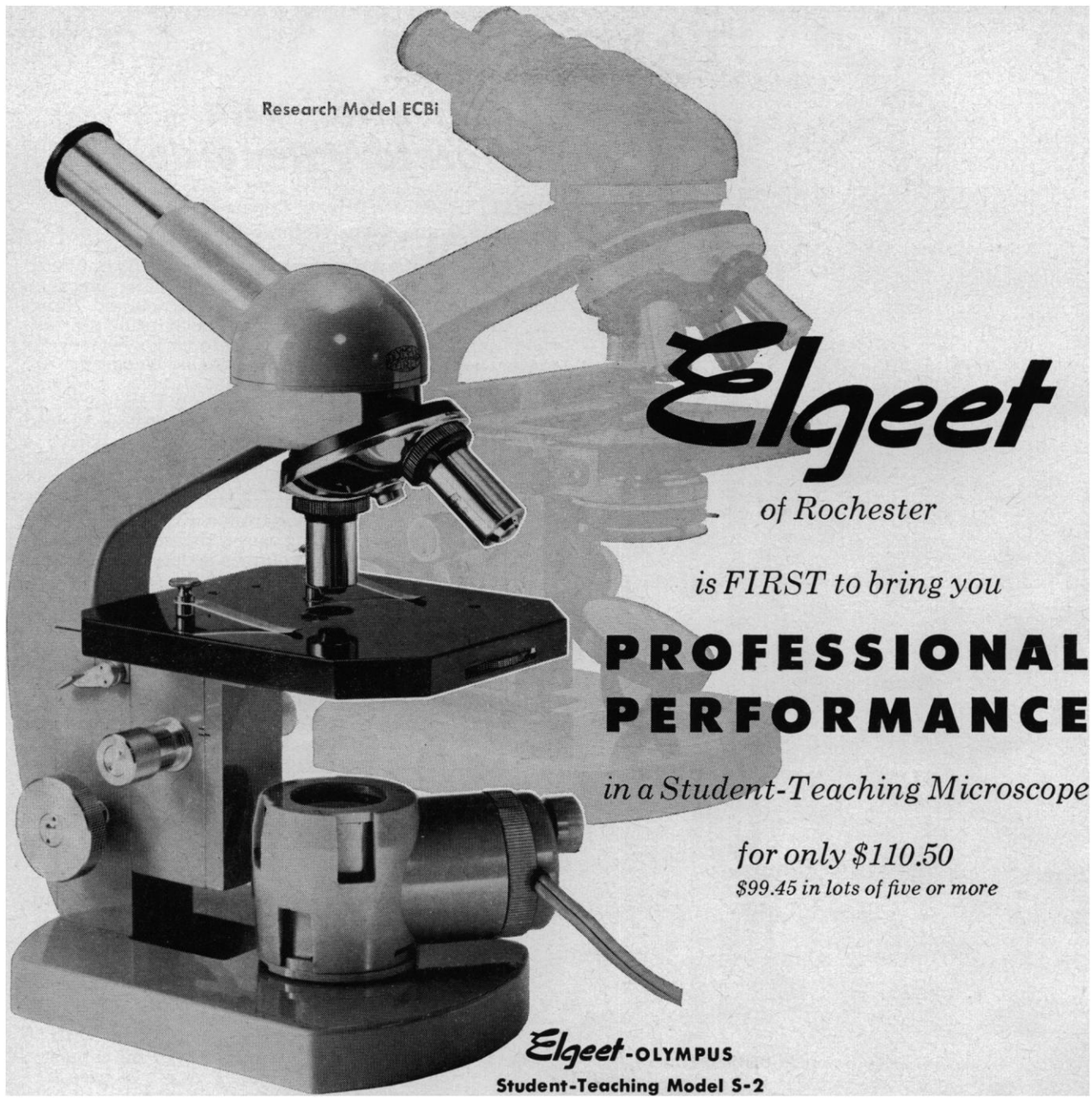

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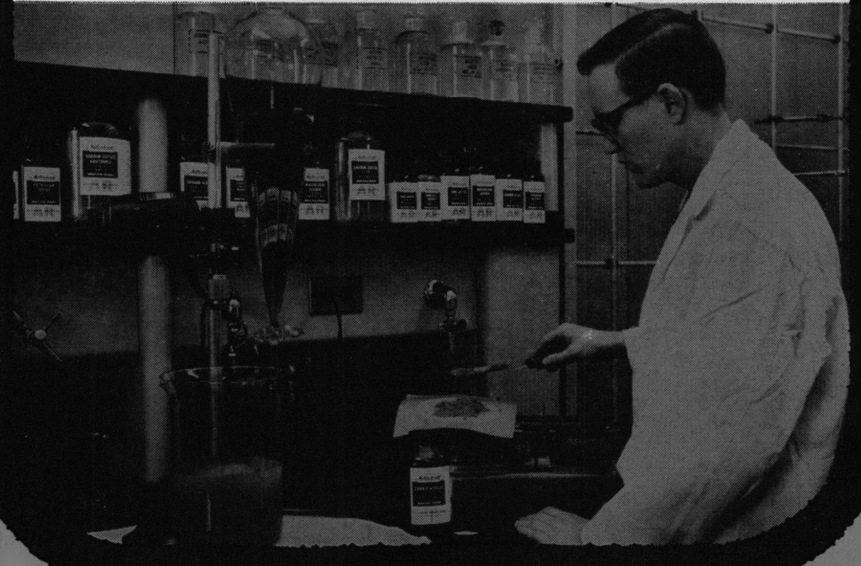

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Letters

Radiation Carcinogenesis

A number of difficulties lie in the way of accepting Blum's thesis [*Science* **130**, 1545 (1959)] that his data on ultraviolet carcinogenesis in mice and his mathematical deductions therefrom are evidence for the concept that there is no threshold dose for radiation carcinogenesis. It is not simply that he is arguing not from data but from projections of that data into unstudied areas, or that this was done even though direct observation was possible. There is also the fact that other data from his series of studies point rather directly to the opposite conclusion. They not only describe a threshold phenomenon but offer some clues as to quantitation.

As to the first objection, Blum in his Fig. 1 presents the incidence data for varying doses of radiation. According to his figure, halving the radiation dose means that 0.15 is added on to the log of the time necessary for tumor development. According to the chart this relation holds for each halving of dose down to 1/32 of the dose required for most rapid carcinogenesis. The chart is described as being based on experiments described in his recent monograph (*1*). Unfortunately, neither the monograph or the original papers I could find deal with doses corresponding to his two lowest curves, and the third dose level is described as treated partly by extrapolation (*2*). Hence it would appear that the dose ranges on which the question of threshold is based are quite narrow, more so than the diagrams would suggest.

If such information were all that were available to us, there would be some justification for making projections therefrom, even though the tentative nature of the projections would have to be emphasized. Actually this is not the case. Blum makes the point that there is a practical limit on the doses of carcinogenic radiation that can be tested because, with low doses, the time for cancer development will be longer than the life span of the animal. Of course, if the first cancers are not to appear until after all animals are dead, we have a practical threshold if not a biologic one. But further than this, our information need not be as limited as Blum claims. He does not spell it out in his article, but all his figures on dose-time relations are concerned with the time within which cancers appear visible to the unaided eye. Nowhere in his work could I find reference to the power of the microscope to detect cancers much earlier in their course. Given his figures for cell size and rate of growth, a cancer should have a cross section of 100 cells visible under the microscope after an interval one-third that necessary for a gross lesion to develop. This means that doses of irradiation supposedly leading to far more slowly growing tumors than have presently been studied are quite accessible to experimental investigation, so that abstract speculation is neither needed nor appropriate.

But beyond these caveats, there is evidence on threshold existence in other work of Blum himself: his studies on the effect of interruption of irradiation and its resumption after a 30-day rest period (*3*). (The figures for 30-percent tumor incidence are the most convenient to analyze because there was a second interruption of radiation in some series before the 50-percent incidence time was reached.) According to these figures, with uninterrupted radiation it took 95 doses of 2×10^7 ergs/cm^2 to produce visible cancer in 30 percent of the animals. Interruption late in the course of treatment, after 53 doses, meant that only 85 doses were needed for tumor production; the tumors apparently grew during the rest period. This, however, was not the case when the interruption occurred earlier in the course of treatment. When the rest period was given after 33 treatments, there was no progression, and the same total of 95 treatments was needed for cancer production as had been true for the controls. By contrast, when the rest period was introduced still earlier, there was recovery from the first course and more radiation was needed than if there had been no interruption. With the break after 23 treatments, an additional 81 treatments for a total of 104 were needed. And if only three or four treatments were given (the actual number is not clear), more radiation (100 doses) was needed after the rest period than if both the rest period and the first doses of radiation had been omitted.

It seems to me that this evidence for reversibility of the effects of small amounts of radiation bears directly on the question of a threshold. For if there is a dose of radiation low enough so that the exposed tissues recover or become even less than normally sensitive to subsequent radiation, this must be a subthreshold dose by definition. It appears that only above a certain dose level are the effects of radiation irreversible and hence inexorably carcinogenic. Hence, from both negative and positive aspects I find myself unable to accept Blum's thesis that no radiation threshold exists for carcinogenesis.

Extrapolation of this work to carcinogenesis by ionizing radiation presents other problems. It is reasonable to think that there might be parallel quantitative patterns. At least it is hard to imagine that there is no correlation between

(*Continued on page 866*)

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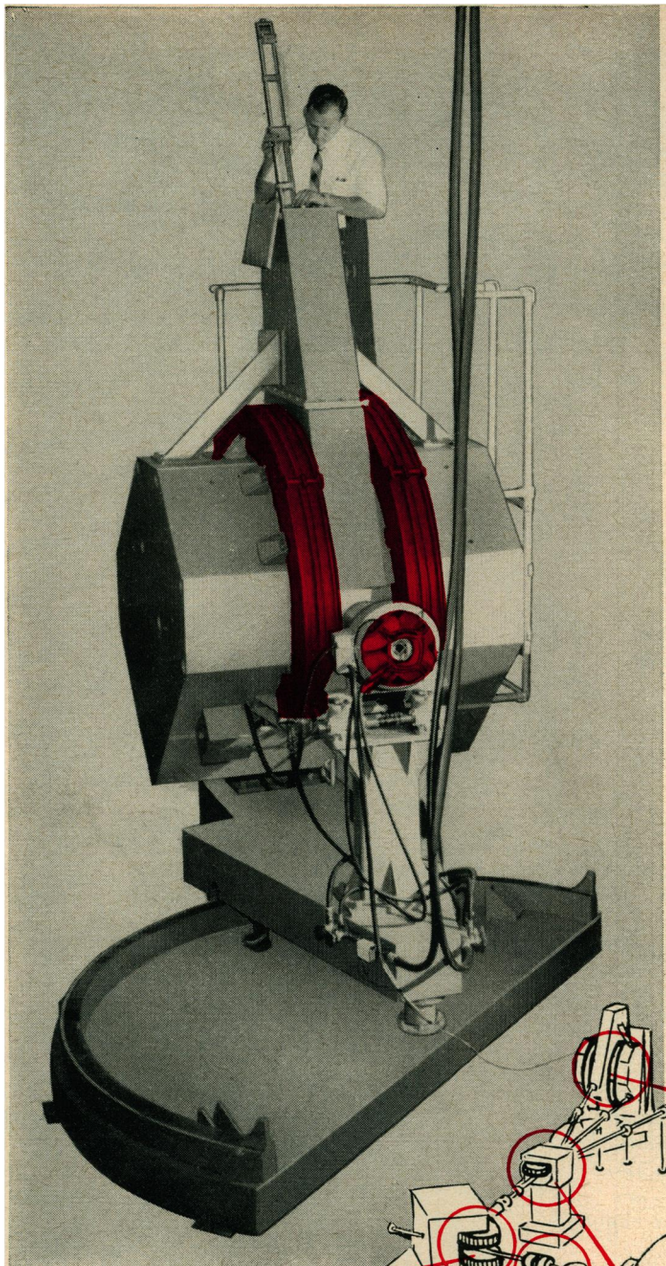

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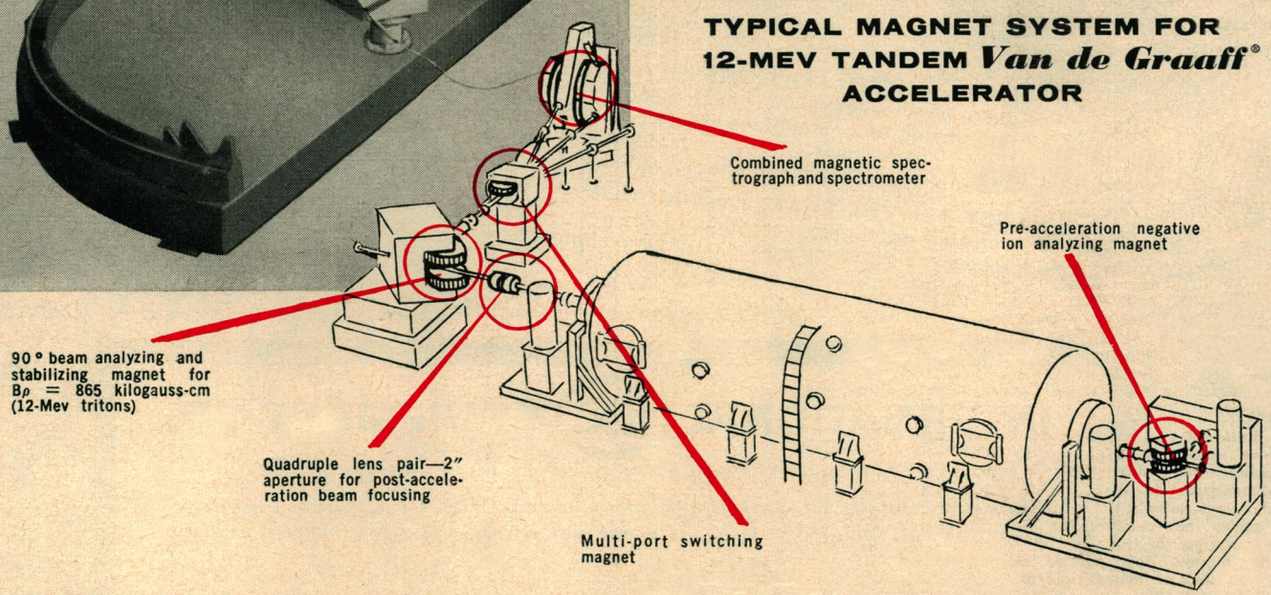

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Space Exploration as Propaganda

Since Veblen introduced the idea of conspicuous consumption, we have recognized that many expenditures are made neither for comfort nor for use, but to maintain one's position in the community. Scientists and public officials in Washington are now wondering to what extent an analogous principle applies to a country seeking to maintain its position in the community of nations. Much of the debate over the adequacy of our space program concerns the question whether comparison of Soviet and American achievements in placing very large payloads in orbit is adversely affecting our prestige abroad.

Among those who see the influence of the United States suffering because of our showing in space is George V. Allen, director of the United States Information Agency. In testimony this year before the House Science and Astronautics Committee, Allen said that many people throughout the world do judge a nation's science and technology in terms of what they can understand of its space efforts. As things have turned out, the testimony continues, Soviet achievements have greatly exceeded world expectations, while our efforts have fallen short. One immediate result of Soviet success, according to Allen, is the better reception now accorded Soviet technological and cultural exports.

A key spokesman for the view that our present rate of achievement in space is adequate is also a key figure—or, rather, the key figure—in the administration. At a news conference, President Eisenhower said that he found no reason for us "to bow our heads in shame." If Soviet efforts have had a greater appeal to the imagination of the public, he continued, actual examination of the record will show that we have done good, hard work.

To consider space exploration in terms of conspicuous consumption is not meant to imply that such exploration is not of genuine scientific import. A Cadillac will get you there and back. Nor is such consideration meant to imply that space exploration is the best indicator that economists can devise to measure a nation's scientific and technological prowess. The question at issue is simply whether space exploration is a measure of power accepted by the people of countries that we want to influence. We may not feel inferior, we may not be inferior, but the question is what does the rest of the world think of us.

To estimate what the rest of the world does make of us, a certain amount of data can be gathered, and a certain range of arguments can be based on that data. If outer space is a subject for research, so is its effect on the opinions and behavior of people. And here we are struck by one aspect of Allen's testimony. He cites in support of his views the results of public opinion polls conducted overseas and also the reports of our government offices overseas.

The information that we now possess, of course, may be too meager to have much influence on our policies, but if such is the case, it is simply an argument that we do something about getting better information. How important space exploration is as propaganda is a question over which sincere men can disagree, but the answer is not simply a matter of intuition.—J.T.

of inorganic chemistry in Europe; Hans Jonassen. *Phosphorus-nitrogen and phosphorus sulfur chemistry* (G. Barth-Wehrenalp, *chairman*): N. L. Paddock; R. Shaw; M. Becke-Goehring; T. Moeller; R. Raetz. (Subjects to be announced.)

Adhesion

Harold F. Wakefield, *chairman*
Robert L. Patrick, *vice chairman*

29 Aug. J. J. Bikerman, "The science of adhesive joints"; F. J. Reil, "Degradation of adhesive joints through heat or aging"; G. R. Irwin, "Mechanism of failure."

30 Aug. F. R. Eirich, "Adsorption of adhesives on surfaces"; W. T. M. Johnson, "Adhesion and the chemical nature of surfaces."

31 Aug. H. E. Farnsworth, "Investigations with atomically clean surfaces"; C. A. May and A. C. Nixon, "Relation between resin composition, physical properties, and bond strength."

1 Sept. John W. Swanson, "Factors which affect adhesion of cellulose fibers." Open session on current problems in adhesion research (John W. Rutzler, discussion leader).

2 Sept. D. V. Rosato, "Science of adhesion through ceramic and inorganic compounds."

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Lipide Metabolism

Carleton R. Treadwell, *chairman*
Jules Hirsch, *vice chairman*

13 June. Cellular aspects of absorption and uptake: Robert M. O'Neal, W. Stanley Hartroft, Wilber A. Thomas, "Electron microscopic studies of lipids in rats fed high-fat diets and single fatty meals"; John Glover, "Intestinal absorption of lipids"; Cecil Entenman and Robert E. Kay, "The uptake, synthesis and release of lipids by the isolated perfused liver"; N. R. Diluzio, "Hepatic cell participation in lipid metabolism."

14 June. Lipide metabolism: Edward J. Masoro, "A study of the regulation of lipide metabolism by experimentally varying the nutrition and environment of a mammal"; Daniel Steinberg and Martha Vaughan, "Adipose tissue metabolism and its control by hormones"; W. L. Gaby, Ihor Zajac, Ronald Silberman, "The role of phospholipids in metabolism." *Sterol metabolism*: R. G. Langdon, "Branched chain acids in biosynthesis of cholesterol"; George Popjak, "The intermediary stages of sterol biosynthesis in the liver."

15 June. Sterol metabolism: Peter D. Klein, "Studies on the metabolism of cholesterol esters"; James L. Gaylor, "Δ^7-cholestenol and related compounds in skin"; R. B. Clayton and Konrad Bloch, "The utilization of sterols in insects." *Sterols and bile acids*: Paul F. Smith, "Uptake and utilization of sterols by pleuropneumonia-like organisms"; James G. Hamilton, "Quantitative and qualitive determination of bile acids by glass paper chromatography."

16 June. Bile acids: Ezra Staple, "The conversion of cholesterol to bile acids: in vitro studies"; S. Bergstrom, "The conversion of cholesterol to bile acids: stereochemical and quantitative aspects"; Liese L. Abell, "Hormonal factors in the metabolism of sterols to bile acids"; S. L. Hsia and John T. Matschiner, "Isolation and identification of new metabolites of bile acids"; Robert B. Failey, Jr., "Some aspects of bile acid metabolism in man."

17 June. Complex lipids: H. E. Carter, "Chemistry of cerebrosides and other glycolipids"; Andrew A. Benson, "Lipid structure and metabolism in photosynthetic tissues"; L. P. Zill and E. A. Harmon, "Biochemical studies of plant lipids."

Cell Structure and Metabolism

S. L. Palay, *chairman*
G. E. Palade, *vice chairman*

20 June. Synthesis of secretory products, especially enzymes and proteins as exemplified in the pancreas (G. C. Hirsch, *chairman*): G. E. Palade; P. Keller; L. E. Hokin; L. C. U. Junqueira; H. Sheldon.

21 June. Synthesis of secretory products in liver and other glands: T. Peters; R. W. Hendler; E. Kuff; W. Bargmann.

22 June. Secretion of ions and water (R. E. Davies, *chairman*): A. Seder; W. S. Rehm; R. D. Wright; G. D. Pappas.

23 June. Endocrine glands (E. Scharrer, *chairman*): S. L. Wissig; S. Wollman, C. P. Leblond; J. Roche, W. H. McShan.

24 June. Secretion by mucoprotein-producing glands: D. W. Fawcett; S. L. Palay; Sir Howard Florey.

Additional speakers and discussions to be announced.

Physical Metallurgy

R. L. Fullman, *chairman*
Michael Bever, *vice chairman*

27 June–1 July. R. D. Seraphim, "Effect of impurities and defects in superconductors"; A. W. Overhauser, "Theory of resistance minimum in dilute paramagnetic alloys"; W. B. Pearson, "Interpretation of relative thermoelectric phenomena in pure metals and dilute alloys at low temperatures"; P. A. Flynn, "Deformation of solid solutions"; D. A. Thomas, "Influence of grain size on deformation"; J. Kruger, "Relationship between surface orientation and film formation in aqueous solutions"; F. W. Young, "Mechanism of dislocation etch pitting"; D. A. Vermilyea,

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"Electrodeposition and defect structure"; J. E. Dorn, "Shock loading"; J. W. Nutting, "Dispersions and creep"; W. W. Smeltzer, "Oxidation characteristics of zirconium, titanium and hafnium"; B. Wagner, "Oxidation of metals in carbon monoxide-dioxide mixtures"; W. A. Backofen, "Ductile fracture"; T. L. Johnston, "Brittle fracture"; D. O. Smith, "Anisotrophy of thin magnetic films"; D. S. Rodbell, "Ferromagnetic resonance studies of whiskers and particles"; S. Chikazumi, "Roll magnetic anisotrophy"; E. A. Nesbitt, "Magnetic annealing in the permalloys and perminvars"; A. Arrott, "Ferromagnetism and antiferromagnetism in alloys"; C. A. Neugebauer, "Some properties of evaporated metal films"; A. J. Forty, "Corrosion cracking."

Chemistry at Interfaces

Herman E. Ries, Jr., *chairman*
Ralph A. Beebe, *vice chairman*

4 July. Thermodynamics of interfaces (L. E. Copeland, *chairman*): T. F. Young, "Thermodynamics of surfaces of electrolytic solutions"; L. Ter Minassian-Saraga, "Ionized monolayers and their free electrical energy"; A. V. Kiselev, "The energy of adsorbate-adsorbent and adsorbate-adsorbate interactions in monolayers on solid surfaces."

5 July. Dispersed systems (H. van Olphen, *chairman*): Robert Ullman, "Light scattering methods in the investigation of surface structure"; C. T. O'Konski, "Electrical properties of dispersed systems"; J. T. G. Overbeek, "The influence of the relaxation effect in electrophoresis and other electrokinetic phenomena."

6 July. Monolayers (H. J. Trurnit, *chairman*): F. M. Fowkes, "Monolayers as two-dimensional solutions"; G. L. Gaines, Jr., "Some cooperative interactions in monolayers"; N. K. Adam, "Developments in monolayer research."

7 July. Monolayers (F. H. Healey, *chairman*): G. E. Boyd, "Theories of the liquid expanded state in monolayers: an experimental study"; Ira Blei, "A study of protein-detergent interaction by monolayer penetration"; Paul Becher, "The effect of surface active agents on the properties of the oil-water interface"; B. V. Derjaguin, "The mechanism of the controlling role of monolayers on the kinetics of some processes in heterogeneous systems."

8 July. Related topics and general discussion.

Chemistry, Physiology, and Structure of Bones and Teeth

B. B. Migicovsky, *chairman*
W. P. Norris, *vice chairman*

11 July. Selected communications (Clayton Rich, *chairman*): W. P. L. Myers and W. Lawrence, Jr., "Studies

on the influence of cortisone on serum calcium homeostasis"; C. A. L. Bassett, "Factors contributing to osteogenesis in vitro"; T. W. Speckman and W. P. Norris, "Variations in retention kinetics of bone seeking isotopes"; J. Samachson and H. Spencer, "Comparison of single and multiple doses of Sr^{85} and Ca^{45} in man"; J. M. Janes, P. J. Kelly, L. F. A. Peterson, "The effect of beryllium on bone, a morphologic study of the progressive changes in rabbit bone." *Bone induction* (Leroy Lavine, *chairman*): J. S. Nicholas, "Induction and its relationship to bone structure"; M. Moss, "Osteogenic induction factors."

12 July. Bone induction (continued) Leroy Lavine, *chairman*): J. J. Pritchard, "Recruitment of osteoblasts relating to bone induction"; Hans Selye, "Induction of bone by tissue scaffoldings." *Nature and mechanism of hard tissue destruction* (Reidar F. Sognnaes, *chairman*): N. M. Hancox, "The osteoclast."

13 July. Nature and mechanism of hard tissue destruction (continued) (Reidar F. Sognnaes, *chairman*): Charles M. Dowse and William Neuman, "Metabolism of bone cells"; George Nichols, Jr., Nancy Nichols, André B. Borle, Stein Schartum, Gilbert Vaes, "Cellular metabolism of bone"; Paul Goldhaber, "Further observations on experimental bone resorption in tissue culture." *Organic matrix in calcification* (M. J. Glimcher, *chairman*): F. Pautard, "The nature of the organic matrix and its role in the development of calcified structures."

14 July. Organic matrix in calcification (continued) (M. J. Glimcher, *chairman*): L. Johnson, "Histochemical changes in organic matrix accompanying calcification"; A. Sobel, "Role of the organic matrix in the nucleation and growth of bone crystals." *Calcium metabolism* (F. McLean, *chairman*): J. Vincent, "Metabolic bone at the histological level."

15 July. Calcium metabolism (continued) (H. F. Deluca, *chairman*): A. M. Shanes, "Movement of calcium in nonskeletal tissues"; M. R. Urist, "Calcium and protein relations in the blood"; R. H. Wasserman, "Passage of calcium across biological membranes."

High Pressure Research

H. G. Drickamer, *chairman*
O. L. Anderson, *vice chairman*

18 July. R. H. Wentorf, Jr., *chairman*: H. T. Hall and F. P. Bundy, "The synthesis of diamond." W. H. Jones, *chairman*: I. S. Bengelsdorf, "Behavior of organic compounds at high temperature and pressure"; I. B. Johns, "Organic reactions at high pressure."

19 July. J. M. Nielsen, *chairman*: R. Laudise and R. Roy, "Hydrothermal and related syntheses"; U. O. Hutton,

D. T. Griggs, A. A. Giardini, "New high pressure techniques and experiments."

20 July. F. B. Bundy, *chairman*: H. M. Strong, L. Coes, F. Birch, "Phase transitions at high pressure." John Jamieson, *chairman*: D. T. Griggs, "Geophysical research at the University of California at Los Angeles"; H. Greenwood, "Recent work on compressed gases."

21 July. D. W. McCall, "NMR studies at high pressure"; W. M. Walsh, Jr., "High pressure resonance work at Harvard." H. G. Drickamer, *chairman*: G. W. Johnson and R. E. Batzel, "The physical and chemical effects of underground nuclear explosions."

22 July. A. van Falkenburg, J. Jamieson, H. G. Drickamer, "Recent high pressure developments."

Chemistry and Metallurgy of Semiconductors

A. J. Rosenberg, *chairman*

25 July. Crystal growth: P. Egli, "Zone concept of crystal growth"; D. A. Vermilyea, "Defect mechanism of crystal growth"; R. L. Longini, "Dendritic crystal growth"; F. H. Horn, "High temperature crystal growth."

26 July. Impurity phenomena: H. J. Vink, "Non-stoichiometry in semiconductors"; H. Reiss, "Interaction of chemical and lattice defects"; K. Weiser, "Theory of solubility of impurities"; J. B. Mullin, "Anisotropic segregation."

27 July. Surface chemistry: C. G. B. Garrett, "Continuum approach to surface reactivity"; H. C. Gatos, "Atomic approach to surface reactivity"; G. Parravano, "Catalytic activity of semiconductor surfaces"; W. W. Harvey, "The semiconductor electrode."

28 July. Chemical bonding in semiconductors: W. B. Pearson, "Valence bond approach"; J. B. Goodenough, "Crystal field approach"; A. R. Von Hippel, "The future of molecular engineering."

29 July. Correlation of physicochemical and electronic properties: O. G. Folberth, "Influence of bond type on electronic properties"; J. B. Conn, "Influence of structure on electronic properties."

Solid-State Studies in Ceramics

J. H. Westbrook, *chairman*
Larry Himmel, *vice chairman*
Microstructural Studies in Ceramics

1 Aug. Geometry: J. E. Hilliard, "New results in quantitative petrography"; J. C. Griffiths, "Definition of micro and macro scale aggregates."

2 Aug. Techniques: H. Pfisterer, "Comparative ceramographic and electron fractographic techniques"; J. J. Comer, "Methods for studying microstructure with the electron microscope"; G. A. Wolff, "Optical studies of microcleavage, bond character, and surface structure in crystalline materials."

3 Aug. Origins: L. H. Van Vlack, "Interfacial energy versus composition of non-metallic phases"; I. I. Kitaigorodskii, "Crystallization and grain growth in glass and ceramic systems." *Structure versus properties*: J. Gurland, "Relationships between microstructure and mechanical properties"; C. Kooy, "Relationships between microstructure and magnetic properties."

4 Aug. Structure versus properties (continued): D. A. Lupfer, "Effects of macrostructure and microstructure on dielectric properties"; R. C. DeVries, "Morphology of ferroelectric domains in $BaTiO_3$ crystals." C. S. Beals, "Meteorites and meteorite craters on the earth and moon."

5 Aug. Structure versus properties (continued): C. P. K. Chu, "Microstructural studies on coatings"; F. Ordway, "Relations between properties and structure in cement and concrete."

Chemistry and Physics of Solids: Point Defects

Robert L. Sproull, *chairman*
Robert Maddin, *vice chairman*

8 Aug. J. M. Whelan, "Interactions of holes, electrons, and electrically active impurities in GaAs"; E. M. Pell, "Lithium impurity interactions in silicon"; H. Brooks, "Key problems in the theory of point defects"; G. H. Vineyard, "Information on point defects from radiation damage."

9 Aug. D. Wilsdorf, "Interaction of point defects and dislocations"; M. J. Makin, "Point defects and mechanical properties of metals"; R. W. Balluffi, "Measurements of equilibrium point defect concentrations"; T. Federighi, "The role of point defects in clustering in supersaturated aluminum alloys."

10 Aug. R. M. Walker, "Radiation damage and point defects in metals"; J. S. Koehler, "The nature of point defects in metals"; H. S. Sack, "Review of dielectric relaxation and internal friction." Round table discussion: R. W. Dreyfus, D. O. Thompson, B. S. Berry, and C. A. Wert.

11 Aug. G. D. Watkins, "Study of defects by electron spin resonance"; C. P. Slichter, "Applications of nuclear magnetic resonance"; W. D. Compton, "Optical studies of point defects in insulators"; S. Zwerdling, "Zeeman effect of impurity excited states in semiconductors."

12 Aug. J. H. Crawford, Jr., "Defect formation in ionic crystals by ionizing radiation."

Toxicology and Safety Evaluations

David W. Fassett, *chairman*
Frank R. Blood, *vice chairman*

15 Aug. B. J. Vos, "The interpretation of carcinogenesis experiments"; R. M. Mulligan, "Comparative pathology of human and canine tumors"; John McGrath, "Neurologic diseases of the dog."

16 Aug. Elliott Maynard, "Use of behavioral techniques in a study of heavy metal poisoning"; Thom Verhave, "The analysis of behavioral patterns in experimental animals"; Charles B. Ferster, "Some applications of behavioral analysis"; J. Teisinger, "Application of Pavloff technics to toxicology."

17 Aug. Problems in the toxicologic evaluation of new drugs—evaluation in animals (Fred Coulston, *chairman*): Kenneth Dubois and John Litchfield, "Evaluation in animals." *Problems in the toxicologic evaluation of new drugs —evaluation in humans* (Sidney Farber, *chairman*): Ralph Jones, K. G. Kohlstaedt, Ralph Smith, "Evaluations in humans."

18 Aug. J. Teisinger, "Significance of biological tests for exposure in industrial toxicology"; T. Clarkson, "Biochemical aspects of heavy metal poisoning"; J. Radomski, "Influence of environmental temperature on toxicologic reactions." Henry Hurtig, *chairman*: Simone Dormal, "Experiences with pesticide residue problems in Europe."

19 Aug. Lewis Schanker, "Absorption of foreign organic compounds from the gut"; K. C. Huang, "Excretion of chemical compounds by the kidney."

Infrared Spectroscopy

D. A. Ramsay, *chairman*
M. K. Wilson, *vice chairman*

22 Aug. G. C. Pimentel, *chairman*: L. Couture-Mathieu, "Infrared and Raman spectra in crystals; J. Fahrenfort, "Infrared reflection spectra"; H. J. Hrostowski, "Electronic absorption of bizarre impurities in silicon and germanium in the infrared region."

23 Aug. B. Crawford, Jr., *chairman*: P. Jaquinot, "Recent advances in the near infrared"; L. Grenzel, "Recent advances in the far infrared"; speaker to be announced, "Recent infrared investigations in Russia."

24 Aug. R. R. Brattain, *chairman*: A. D. Buckingham, "Theory of solvent effects in infrared spectra"; W. B. Person, "Infrared intensities"; A. C. Jones, "Measurement of real Raman intensities."

25 Aug. M. K. Wilson, *chairman*; M. A. Eliashevich, "Molecular vibrations"; J. Overend, "Molecular force fields"; L. J. Bellamy, "Infrared spectra of large molecules."

26 Aug. W. J. Potts, *chairman*: W. Klemperer, "High temperature studies in the infrared"; C. H. Townes, "Progress report on the status of infrared masers."

High-Temperature Chemistry: Kinetics of Vaporization and Condensation Processes

Leo Brewer, *chairman*
Paul W. Gilles, *vice chairman*

29 and 30 Aug. Effusion studies: Robert J. Thorn; R. S. Bradley; Thomas E. Phipps; George W. Winslow; K. Douglas Carlson.

30 Aug. Transpiration studies: U. Merten.

31 Aug. Crystal growth and condensation coefficients: G. W. Sears and J. P. Hirth.

1 and 2 Sept. Mass spectroscopy and field emission microscopy: W. A. Chupka; John McKinley; Paul Schissel; Robert Comer.

Forthcoming Events

April

7–9. Optical Soc. of America, Washington, D.C. (K. S. Gibson, OSA, Natl. Bureau of Standards, Washington 25.)

8–9. American Assoc. of University Professors, Detroit, Mich. (P. R. David, Univ. of Oklahoma, Norman.)

8–9. New Mexico Acad. of Science, Socorro. (K. G. Melgaard, P.O. Box 546, University Park, N.M.)

8–9. Southern Soc. for Philosophy and Psychology, Biloxi, Miss. (E. Henderson, Florida State Univ. Tallahassee.)

8–11. American Dermatological Assoc., Boca Raton, Fla. (W. M. Sams, 308 Ingraham Bldg., Miami 32, Fla.)

9–10. Histochemical Soc., 11th annual,

New York, N.Y. (H. W. Deane, Albert Einstein College of Medicine, Bronx 61, N.Y.)

10–11. American Soc. for Artificial Internal Organs, Chicago, Ill. (C. K. Kirby, ASFAIO, 3400 Spruce St., Philadelphia 4, Pa.)

11–13. American College of Surgeons, Minneapolis. Minn. (H. P. Saunders, 40 E. Erie St., Chicago 11, Ill.)

11–13. Electrical Engineering in Space Technology, 1st conf. (AIEE), Dallas, Tex. (B. J. Wilson, Naval Research Laboratory, Washington, D.C.)

11–13. Forest Tree Growth, intern. conf., Tucson, Ariz. (Forest Tree Growth Conf., Laboratory of Tree-Ring Research, Univ. of Arizona, Tucson.)

11–14. American College Personnel Assoc., Philadelphia, Pa. (M. D. Hardee, Florida State Univ., Tallahassee.)

11–14. American Meteorological Soc., 8th weather radar conf., San Francisco, Calif. (H. G. Houghton, AMS, Dept. of Meteorology, Massachusetts Inst. of Technology, Cambridge 39.)

11–15. American Assoc. of Immunologists, Chicago, Ill. (C. Howe, Columbia Univ., College of Physicians and Surgeons, New York 22.)

11–15. American Inst. of Nutrition, Chicago, Ill. (G. M. Briggs, Div. of General Medical Sciences, National Institutes of Health, Bethesda, Md.)

11–15. American Physiological Soc., Chicago, Ill. (R. G. Daggs, 9650 Wisconsin Ave., NW, Washington 14.)

11–15. American Soc. for Experimental Pathology, Chicago, Ill. (F. J. A. McManus, Univ. of Alabama Medical Center, Birmingham.)

11–15. American Soc. for Pharmacology and Experimental Therapeutics, Chicago, Ill. (K. H. Beyer, Merck, Sharp & Dohme Research Laboratories, West Point, Pa.)

11–15. Federation of American Socs. for Experimental Biology, Chicago, Ill. (M. O. Lee, 9650 Wisconsin Ave., NW, Washington 14.)

11–16. American Assoc. of Anatomists, New York, N.Y. (L. B. Flexner, Dept. of Anatomy, School of Medicine, Univ. of Pennsylvania, Philadelphia 4.)

11–16. American Soc. of Biological Chemists, Chicago, Ill. (F. W. Putnam, Dept. of Biochemistry, Univ. of Florida, Gainesville.)

11–16. Anatomical Congress, 7th intern., New York, N.Y. (D. W. Fawcett, Dept. of Anatomy, Harvard Medical School, Boston 15, Mass.)

11–16. Congress of Anatomy, 7th intern., New York, N.Y. (J. C. Hinsey, New York Hospital, Cornell Medical Center, 525 E. 68 St., New York 21.)

12. Microcirculatory Conf., 8th, New York, N.Y. (H. J. Berman, Dept. of Biology, Boston Univ., Boston 15, Mass.)

12–13. Microbial Genetics, symp., London, England. (B. W. Lacey, Soc. for General Microbiology, Dept. of Bacteriology, Westminster Medical School, London, S.W.1.)

13–15. American Public Health Assoc. (Southern Branch), Memphis, Tenn. (L. M. Groves. Shelby County Health Dept., Memphis.)

15–16. Eastern Psychological Assoc., New York, N.Y. (C. H. Rush, Standard

Oil Co. (N.J.), Rockefeller Plaza, New York, N.Y.)

16. Pennsylvania Acad. of Science, Williamsport. (K. B. Hoover, Messiah College, Grantham, Pa.)

18–19. Automatic Techniques Conf., 3rd annual, Cleveland, Ohio. (N. S. Hibshman, American Inst. of Electrical Engineers, 33 W. 39 St., New York 18.)

18–19. Radioactivity in Man, Measurements and Effects of Internal Gamma Ray Emitting Radiosotopes, AAAS symp., Nashville, Tenn. (G. R. Meneely, School of Medicine, Vanderbilt Univ., Nashville 5.)

18–20. National Watershed Conf., 7th, Washington, D.C. (J. H. Jones, American Watershed Council, Fairmont, W.Va.)

18–21. American Astronomical Soc., Pittsburgh, Pa. (J. A. Hynek, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 38, Mass.)

18–22. Association of American Geographers, Dallas, Tex. (A. C. Gerlach, Map Div., Library of Congress, Washington 25.)

18–22. European Soc. of Ophthalmology, 1st cong., Athens, Greece. (P. Velissaropoulis, c/o Ophthalmology Clinic, Faculty of Medicine, 26, rue de l'Université, Athens, Greece.)

19–21. Active Networks and Feedback Systems, 10th intern. symp., New York, N.Y. (H. J. Carlin, Microwave Research Inst., Polytechnic Inst. of Brooklyn, 55 Johnson St., Brooklyn 1, N.Y.)

19–21. American Soc. of Lubrication Engineers, annual, Cincinnati, Ohio. (C. L. Willey, ASLE, 84 E. Randolph St., Chicago, Ill.)

19–22. Metallurgy of Plutonium—session on nuclear fuels, intern, symp., Grenoble, France. (Société Française de Métallurgie, 25, rue de Clichy, Paris, France.)

20–21. Council on Medical Television, 2nd meeting, Bethesda, Md. (J. Mackenzie, Council on Medical Television, 33 E. 68 St., New York 21.)

20–22. Biological Waste Treatment, 3rd conf., New York, N.Y. (W. W. Eckenfelder, Dept. of Civil Engineering, Manhattan College, New York 71.)

20–22. Manned Space Stations Inst. of the Aeronautical Sciences symp., Los Angeles, Calif. (E. Levin, Rand Corp., 1700 Main St., Santa Monica, Calif.)

20–22. Medical Electronics, natl. conf., Houston, Tex. (K. O. Heintz, Humble Oil and Refining Co., Houston.)

20–22. Southwestern Inst. of Radio Engineers, 12th annual, Houston, Tex. (H. E. Childers, College of Medicine, Baylor Univ., Waco, Tex.)

20–23. National Council of Teachers of Mathematics, Ann Arbor, Mich. (M. H. Ahrendt, 1201 16 St., NW, Washington 6.)

20–24. Congress of Gastroenterology, 6th intern., Leyden and Noordwiik aan Zee, Netherlands. (C. Schreuder, 16, Lange Voorhout, The Hague, Netherlands.)

21–22. Society of Technical Writers and Editors (Technical Publishing Soc.), 7th annual, Chicago, Ill. (R. F. Ellis, American Can Co., 11th Ave. and St. Charles Rd., Maywood, Ill.)

21–23. Association of Southeastern Biologists, New Orleans, La. (H. J. Humm, Dept. of Botany, Duke Univ., Durham, N.C.)

21–28. American Soc. of Tool Engineers, annual, Detroit, Mich. (H. E. Conrad, ASTE, 10700 Puritan Ave., Detroit.)

22–23. High-Temperature Resistance and Thermal Degradation of Polymers, symp., London, England. (Symposium Sub-Committee, Plastics and Polymer Group, Soc. of Chemical Industry, 14 Belgrave Sq., London, S.W.1, England.)

24–28. American Ceramic Soc., annual, Philadelphia, Pa. (F. P. Reid, ACS, 4055 N. High St., Columbus 14, Ohio.)

25–27. American Proctologic Soc., Houston, Tex. (N. D. Nigro, 10 Peterboro, Detroit 1, Mich.)

25–27. Canadian Inst. of Mining and Metallurgy, 62nd annual, Toronto, Ontario, Canada. (Secretary-Treasurer, Room 906, Drummond Bldg., 1117 St. Catherine St., Montreal, Canada.)

25–27. International Acad. of Pathology, Memphis, Tenn. (F. K. Mostofi, Armed Forces Inst. of Pathology, Washington, D.C.)

25–28. American Assoc. of Petroleum Geologists, Atlantic City, N.J. (H. T. Morley, Pan American Petroleum Corp., Box 591, Room 1330, Tulsa 2, Okla.)

25–28. Society of Economic Paleontologists and Mineralogists, Atlantic City, N.J. (J. Imbrie, Dept. of Geology, Columbia Univ., New York, N.Y.)

25–30. American Acad. of Neurology, Miami, Fla. (Mrs. J. C. McKinley, 4307 E. 50 St., Minneapolis, Minn.)

25–30. Industrial Health, conf., Rochester, N.Y. (M. E. Fairbank, Kodak Park, Rochester 4.)

26–29. Internal Medical Assoc., Rochester, N.Y. (C. D. Bridges, 28 E. Jackson Blvd., Chicago 4.)

27. Additives and Residues in Human Foods, symp., Columbia, Mo. (T. D. Luckey, Dept. of Biochemistry, School of Medicine, Univ. of Missouri Medical Center, Columbia.)

27. International Acad. of Proctology, annual, Miami Beach, Fla. (A. J. Cantor, IAP, 147-41 Sanford Ave., Flushing 55, N.Y.)

27–29. Algae and Metropolitan Wastes, conf., Cincinnati, Ohio. (A. F. Bartach, Water Supply and Water Polution Research, Robert A. Taft Sanitary Engineering Center, Cincinnati.)

27–29. Chemical Reaction Engineering —Section on Non-Conventional Reactors, 2nd European symp., Amsterdam, Netherlands. (P. J. Hoftijzer, Centraal Laboratorium Staatsmijnen, Geleen (L.), Netherlands.)

27–30. American Meteorological Soc., general meeting with American Geophysical Union, Washington, D.C. (K. C. Spengler, AMS, 45 Beacon St., Boston 8, Mass.)

28–30. American Assoc. of Pathologists and Bacteriologists, Memphis, Tenn. (R. L. Holman, Dept. of Pathology, Louisiana State Univ., School of Medicine, New Orleans.)

28–30. American Soc. of Human Genetics, Memphis, Tenn. (W. J. Schull, Dept. of Human Genetics, Univ. of Michigan, 1133 E. Catherine St., Ann Arbor.)

28–30. Current Concepts in Medicine, 2nd intern. symp., Philadelphia, Pa. (M. J. Schwartz, Deborah Hospital, 901 Walnut St., Philadelphia 7.)

28–30. Midwestern Psychological Assoc., Columbus, Ohio. (I. E. Farber, Dept. of Psychology, State Univ. of Iowa, Iowa City.)

29. Parenteral Drug Assoc., Philadelphia, Pa. (H. E. Boyden, PDA, 4865 Stenton Ave., Philadelphia 44.)

29–30. Thermonuclear Processes, conv., London, England. (Institution of Electrical Engineers, Savoy Pl., London, W.C.2.)

30. Idaho Acad. of Science, annual, Pocatello. (A. E. Taylor, Graduate Div., Idaho State College, Pocatello.)

30–2. Society for American Archaeology, Salt Lake City, Utah. (D. A. Baerreis, Sterling Hall, Univ. of Wisconsin, Madison 6.)

May

1–2. American Soc. for Clinical Investigation, Atlantic City, N.J. (S. J. Farber, New York University College of Medicine, 550 First Ave., New York 16)

1–5. American Assoc. of Cereal Chemists, Chicago, Ill. (J. W. Pence, Western Utilization Research and Development Div., 800 Buchanan St., Albany 10, N.Y.)

1–5. Electrochemical Soc., Chicago, Ill. (H. B. Linford, ES, 1860 Broadway, New York 23)

1–5. Society of American Bacteriologists, 60th annual, Philadelphia, Pa. (D. M. Cleary, Box 354, Upper Darby, Pa.)

2. American Federation for Clinical

Research, Atlantic City, N.J. (J. E. Bryan, 250 W. 57 St., New York 19)

2–3. Reactions between Complex Nuclei, 2nd conf., Gatlinburg, Tenn. (R. S. Livingston, Oak Ridge Natl. Laboratory, Oak Ridge, Tenn.)

2–4. Aeronautical Electronics, conf., Dayton, Ohio. (L. G. Cumming, IRE, 1 E. 79 St., New York 21)

2–5. Flight Test Symp., natl., San Diego, Calif. (H. S. Kindler, Instrument Soc. of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

2–11. International Cancer Cytology conf., Mexico, D.F., Mexico. (Office of Intern. Conferences, Department of State, Washington 25)

2–11. Pan American Medical Assoc., cong., Mexico City, Mexico. (J. J. Eller, 745 Fifth Ave., New York 22)

3–4. Association of American Physicians, Atlantic City, N.J. (P. B. Beeson, Yale Univ. School of Medicine, New Haven 11, Conn.)

3–4. Conference of Veterinarians, annual, Philadelphia, Pa. (W. H. Rhodes, School of Veterinary Medicine, Univ. of Pennsylvania, Philadelphia 4.)

3–5. Society of Pediatric Research, Swampscott, Mass. (C. D. West, Children's Hospital, Cincinnati 29, Ohio)

3–6. Fuel Element Fabrication, symp., Vienna, Austria. (Intern. Atomic Energy Agency, 11 Kärntner Ring, Vienna)

5–6. American Pediatric Soc., annual, Swampscott, Mass. (A. C. McGuinness, 2800 Quebec St., N.W., Washington 8)

5–8. Wilson Ornithological Soc., Gatlinburg, Tenn. (A. M. Bagg, Farm St., Dover, Mass.)

6–7. Population Assoc. of America, annual, Washington, D.C. (K. B. Mayer, Dept. or Sociology and Anthropology, Brown Univ., Providence 12, R.I.)

6–7. South Dakota Acad. of Science, 45th annual, Brookings. (J. M. Winter, Dept. of Botany, Univ. of South Dakota, Vermillion.)

6–8. International Cong. of Phlebology, 1st, Chambéry, France. (J. Marmasse, 3, rue de la République, Orléans (Loiret), France)

6–9. American Psychoanalytic Assoc., annual, Atlantic City, N.J. (Mrs. H. Fischer, 36 W. 44 St., New York 36)

7–8. Academy of Psychoanalysis, annual, Atlantic City, N.J. (M. Ross, American Psychiatric Assoc., 1700 18 St., N.W., Washington 9)

9. American Acad. of Child Psychiatry, annual, Atlantic City, N.J. (M. Ross, American Psychiatric Assoc., 1700 18 St., N.W., Washington 9)

9–10. American Soc. of Safety Engineers, Chicago, Ill. (A. C. Blackman, ASSE, 5 N. Wabash Ave., Chicago 2)

9–11. Aerospace Medical Assoc., 31st annual, Bal Harbour, Fla. (W. J. Kennard, AMA, Washington Natl. Airport, Washington 1)

9–11. Power Instrumentation, 3rd natl. symp., San Francisco, Calif. (H. S. Kindler, Instrument Soc. of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

9–11. Radiation Research Soc., 8th annual, San Francisco, Calif. (E. L. Powers, RRS, Argonne Natl. Laboratory, Box 299, Lemont, Ill.)

9–12. American Rocket Soc., semi-annual, Los Angeles, Calif. (A. F. Den-

ham, ARS, 925 Book Bldg., Detroit 26, Mich.)

9–12. Instrumentation Automation Conf. and Exhibit, summer, San Francisco, Calif. (Instrument Soc. of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

9–13. American Psychiatric Assoc., annual, Atlantic City, N.J. (C. H. H. Branch, 156 Westminster Ave., Salt Lake City, Utah)

9–14. Fermentation, intern. symp., Rome, Italy. (Intern. Fermentation symp., Istituto Superiore di Sanita, Viale Regina Elena, 299, Rome, Italy)

10–12. Electronic Components, conf., Washington, D.C. (N. S. Hibsham, AIEE, 33 W. 39 St., New York 18)

10–12. Farm Electrification, conf., Omaha, Neb. (N. S. Hibsham, AIEE, 33 W. 39 St., New York 18)

10–12. Severe Storms, American Meteorological Conf., St. Louis, Mo. (K. C. Spengler, AMS, 45 Beacon St., Boston 8, Mass.)

10–13. Fuel Element Fabrication, symp., Vienna, Austria. (Intern. Atomic Energy Agency, 11 Kärntner Ring, Vienna)

11. Society of Medical Psychoanalysts, annual, New York, N.Y. (M. Ross, American Psychiatric Assoc., 1700 18 St., N.W., Washington 9)

11–13. American Assoc. of Genito-Urinary Surgeons, Dearborn, Mich. (W. J. Engel, 2020 E. 93 St., Cleveland 6, Ohio)

11–13. American Assoc. of Physical Anthropologists, Washington, D.C. (E. E. Hunt, Jr., Peabody Museum, Harvard Univ., Cambridge 38, Mass.)

11–13. American Assoc. for Thoracic Surgery, 40th annual, Miami Beach, Fla. (H. T. Langston, 7730 Carondelet Ave., St. Louis 5, Mo.)

11–13. American Inst. of Chemists, Minneapolis, Minn. (L. Van Doren, AIC, 60 E. 42 St., New York 17)

11–13. International Acetylene Assoc., annual, Seattle, Wash. (IAA, 30 W. 42 St., New York 17)

11–13. Rare Earths in Biochemical and Medical Research, conf., Ames, Iowa. (J. G. Graca, College of Veterinary Medicine, Iowa State Univ., Ames)

11–14. American Helicopter Soc., annual natl. forum, Miami Beach, Fla. (H. M. Lounsbury, AHS, 2 E. 64 St., New York 21)

11–14. National Science Fair-International, Indianapolis, Ind. (Science Service, 1719 N. St., Washington 6)

12. Protein and Amino Acid Supplementation, Chicago, Ill. [J. T. Sime (Assoc. of Vitamin Chemists), Evaporated Milk Assoc., 228 North La Salle St., Chicago 1]

12–14. American Assoc. for Cleft Palate Rehabilitation, Denver, Colo. (D. C. Spriestersbach, University Hospitals, Iowa City, Iowa)

12–14. American Inst. of Industrial Engineers, annual, Dallas, Tex. (F. J. Titler, AIIE, 145 N. High St., Columbus 15, Ohio)

13–14. Proctological Latina, 2nd intern., Rome, Italy. (G. B. E. Simonetti, Via S. Raffaele 3, Milano, Italy)

15–18. American Soc. of Maxillofacial Surgeons, Los Angeles, Calif. (E. C. Hinds, 1508 Medical Towers, Houston 25, Tex.)

15–18. International College of Sur-

geons, 12th biennial conf., Rome, Italy. (ICS, 1516 Lake Shore Drive, Chicago, Ill.)

15–20. American Water Works Assoc., annual conv., Miami Beach, Fla. (H. E. Jordan, AWWA, 2 Park Ave., New York 16)

15–19. Institute of Food Technologists, 20th annual, San Francisco, Calif. (C. S. Lawrence, IFT, 176 W. Adams St., Chicago 3)

15–20. National Tuberculosis Assoc., Los Angeles, Calif. (J. C. Stone, 1790 Broadway, New York 19)

16–17. Society of American Military Engineers, natl. conv., Washington, D.C. (D. A. Sullivan, SAME, 140 S. Dearborn St., Chicago, Ill.)

16–18. American Opthalmological Soc., Colorado Springs, Colo. (M. C. Wheeler, 30 W. 59 St., New York 19)

16–18. American Trudeau Soc., Los Angeles, Calif. (F. W. Webster, 1790 Broadway, New York 19)

16–19. American Urological Assoc., Chicago, Ill. (W. P. Didusch, 1120 N. Charles St., Baltimore 1, Md.)

16–20. Medical Library Assoc., Kansas City, Mo. (Miss N. A. Mehne, Upjohn Co. Library, 301 Henrietta St., Kalamazoo, Mich.)

16–21. American Assoc. on Mental Deficiency, annual, Baltimore, Md. (N. A. Dayton, P.O Box 51, Mansfield Depot, Conn.)

17–18. Superconductive Technique for Computing Systems, symp., Washington, D.C. (Miss J. Leno, Code 430A, Office of Naval Research, Washington 25)

17–20. American Assoc. of Plastic Surgeons, Milwaukee, Wis. (T. D. Cronin, 6615 Travis St., Houston 25, Tex.)

18–19. Agricultural Meteorology, 3rd conf., Kansas City, Mo. (K. C. Spengler, American Meteorological Soc., 45 Beacon St., Boston, Mass.)

18–20. Society for Experimental Stress Analysis, spring, Indianapolis, Ind. (W. M. Murray, SESA, P.O. Box 168, Central Square Station, Cambridge 39, Mass.)

18–27. Wool Conf., intern., Harrogate, Yorkshire, England. (A. W. Bennett, Textile Inst., 10 Blackfriars St., Manchester 3, England)

22–26. Air Pollution Control Assoc., 53rd annual, Cincinnati, Ohio. (C. W. Gruber, 2400 Beekman St., Cincinnati 14)

22–26. Oil and Gas Power Conf., Kansas City, Mo. (D. B. MacDougall, ASME, 29 W. 39 St., New York 18)

23–25. American Soc. for Quality Control, annual conv., San Francisco, Calif. (W. P. Youngclaus, Jr., ASQC, 161 W. Wisconsin Ave., Milwaukee 3, Wis.)

23–25. National Telemetering Conf., Santa Monica, Calif. (A. F. Denham, American Rocket Soc., 925 Book Bldg., Detroit 26, Mich.)

23–25. Technical Assoc. of the Paper and Pulp Industry, Chicago, Ill. (J. Winchester, TAPPI, 155 E. 44 St., New York 17)

23–26. Design Engineering Conf., New York, N.Y. (D. B. MacDougall, ASME, 29 W. 39 St., New York 18)

23–28. American College of Cardiology, 9th annual conv., Indianapolis, Ind. (G. F. Greco, ACC, 114-08 Linden Blvd., Ozone Park 16, N.Y.)

23–28. Instruments, Electronics, and Automation Exhibition, Olympia, London, England. (Industrial Exhibitions Ltd., 9 Argyll St., London, W.1., England)

23–28. International Ceramic Cong., 7th, Great Britain. (G. N. Hodson, Organizing Council, c/o Hathernware Ltd., Loughborough, England)

23–28. International War—Prophylaxis Cong. for Physicians, Noordwijk ann Zee, Netherlands. (M. Knap, 46 Schubertstraat, Amsterdam, Netherlands)

25–26. Refractory Metals and Alloys, symp., Detroit, Mich. (E. O. Kirkendall, AIIE, 29 W. 39 St., New York 18)

25–5. International Federation for Housing and Town Planning, cong., Puerto Rico. (IFHTP, Park Hotel, Molenstraat 53, The Hague, Netherlands)

26–27. Psychophysiological Aspects of Space Flight (School of Aviation Medicine, USAF Aerospace Medical Center), symp., San Antonio, Tex. (J. Harmon, Southwest Research Inst., 8500 Culebra Rd., San Antonio 6)

26–28. Society of Naval Architects and Marine Engineers, spring, Washington, D.C. (W. N. Landers, SNAME, 74 Trinity Pl., New York 6)

29–2. Chemical Inst. of Canada, 43rd annual conf., Montreal, Quebec, Canada. (CIC, 18 Rideau St., Ottawa, Ontario, Canada)

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 making 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.*

■ WHEATSTONE BRIDGE measures resistance from 0 to 11,111 Mohm. Complete guarding is said to assure accuracy of ±0.01 percent to 1 Mohm and ±0.02 percent to 100 Mohm. Resistors may be tested at full battery potential up to 150 volts. The bridge is adjusted by dial-type selector switches. (Leeds & Northup Co., Dept. Sci383, 4934 Stenton Ave., Philadelphia 44, Pa.)

■ DIGITAL-TO-ANALOG CONVERTER consists of individual solid-state modules for each input bit. Inputs are a digital number and an a-c voltage. Output is an a-c voltage of identical frequency and of amplitude equal to the product of the inputs. Accuracies of ±0.025 percent and switching times less than 100 μsec are said to be available, with phase shift of 5 deg at 200 kcy/sec. Operating temperature range is −54° to +95°C. A ten-bit device occupies less than 20 in^3. (Packard Bell Computer Corp., Dept. Sci391, 1905 Armacost Ave., Los Angeles 25, Calif.)

■ TEMPERATURE MEASURING INSTRUMENT for use with resistance-type temperature probes measures from −425° to +800°F in 12 ranges, selected by push button. Accuracy is said to be ±0.5°F over the major portion of the range. Power supply can be either a self-contained battery or a 60-cy/sec, 110-volt source. Full interchangeability among probes and instruments is provided. (Trans-Sonics Inc., Dept. Sci-392, Burlington, Mass.)

■ NOISE INTEGRATOR designed to be used with the manufacturer's noise survey meter reads either noise exposure integrated over 5 sec or average noise level with an averaging time constant of 3 sec. A weighted frequency-response signal that emphasizes the frequency ranges in which the ear is susceptible to damage is fed into the instrument from the survey meter. The instrument is designed to be strap-carried by the operator, which leaves his hands free. (Mine Safety Appliance Co., Dept. Sci393, Pittsburgh, Pa.)

■ X-Y RECORDER is designed to operate with differential-transformer input to provide multiplication of mechanical movement by a factor of 1000. Motion as small as 20 μin. is said to be detectable, with total error less than ±0.15 percent. Chart size is 24 by 36 in. A dual vacuum-hold-down system permits

use of half-size sheets. Standard pen speed is 2 in./sec; special speeds to 20 in./sec can be supplied. (Houston Instrument Corp., Dept. Sci394, 1717 Clay Ave., Houston 3, Tex.)

■ RECORDING SPECTROPOLARIMETER measures rotatory dispersion over the 200 to 700 mμ wavelength range. The optical system of the instrument includes a xenon-lamp source with electromagnetic-field arc control; a Littrow monochromator of spectral dispersion varying from 1.3 mμ/mm at 200 mμ to 50 mμ/mm at 700 mμ; and a polarimeter. A servosystem drives the polarizer prism to compensate for the optical rotation introduced by the sample. The recorder is mechanically linked to the wavelength-scan or time-scan motions and to the polarizer-prism rotation. Three optical-rotation ranges are 2, 20 and 200 deg, dextro or levo. Sensitivity of optical rotation measurement is ±0.001 deg. Recording chart area is 500 by 1000 mm. Scanning times range from 5 to 2000 min at nine speeds. Provision is made for kinetic recording at fixed wavelength. (Rudolph Instruments Engineering Co., Dept. Sci387, Little Falls, N.J.)

■ PALLADIUM LEAK VALVE for control of flow of hydrogen and deuterium consists of a chamber 3.5 in. in diameter and 4.5 in. high, with a palladium thimble. The valve is heated by an external 117-volt a-c heater. Input pressure can be as high as 15 lb/in.² gage. Input and output connections are female ⅛-in. diameter pipe fittings. (Scientific Engineering Laboratories, Inc., Dept. Sci415, 1510 Sixth St., Berkeley 10, Calif.)

■ HIGH-VACUUM PUMP is a cold-cathode discharge type designed to be permanently attached to vacuum devices such as microwave tubes to remove minute amounts of gas liberated during the life of the device. The pumps handle 0.7 lit./sec. Various modifications to expedite connection to complex devices are available. Pump with magnet weighs 2 lb. A matching power supply is available. (Ultek Corp., Dept. Sci396, 920 Commercial St., Palo Alto, Calif.)

■ PUNCHED-TAPE READER is designed to read a fixed block of information, up to 384 bits, on standard 1-in., 5- to 8-hole tape. Output terminals are available for all bits through brush contacts. (Wang Laboratories, Inc., Dept. Sci407, 12 Huron Dr., Natick, Mass.)

■ MICROWAVE HARMONIC GENERATORS are available in three models providing output frequencies from 53 to 90 kMcy/sec. The generators consist of two wave guides coupled by a probe

structure terminated in a crystal element. The input wave guide receives the exciting frequency that is coupled to the crystal to cause harmonic generation in the output wave guide. (Narda Microwave Corp., Dept. Sci400, 118-160 Herricks Rd., Mineola, N.Y.)

■ FILM CLEANER is an automatic machine for the solvent cleaning of motion-picture film and magnetic-recorder tape. Speed is adjustable to 300 ft/min. Automatic shutoff leaves the machine threaded with leader for continuous operation. Only nonexplosive, noninflammable solvents are used. Models are available for film sizes from 16 to 70 mm. (Computer-Measurements Co., Dept. Sci420, 12970 Bradley Ave., Sylmar, Calif.)

■ HOT WIRE ANEMOMETER SYSTEM for analysis of airstream turbulence measures longitudinal and transverse components. Separate constant-current supplies and separate d-c bridge circuits are provided for each of two wires. The instrument's amplifier is provided with adjustable frequency compensation to match hot-wire time constants between 0.23 and 30 msec. A sum-difference meter permits indication of each wire resistance separately, of their sum, or of their difference. A random-signal meter provides flat response within ±0.2 db from 2 cy to 250 kcy/sec with averaging time constant of 0.5 or 16 sec. (Flow Corp., Dept. Sci429, 85 Mystic St., Arlington 74, Mass.)

■ COUNTER-TIMERS are completely transistorized instruments for the measurement of frequency and time and for counting. Three models available include a universal counter-timer, a frequency-period meter, and a time interval meter. Measurement ranges of the universal model are: d-c to 10 Mcy/sec for frequency; 0.1 mμsec to 10^7 sec for time interval and period. Accuracy is said to be ±1 count ±oscillator stability. Sensitivity is 0.25 volt r.m.s. and input impedance is 25 kohm/volt. Display is either by vertical numeral panels or by in-line gas-discharge numeral tubes. (Computer-Measurements Co., Dept. Sci405, 12970 Bradley Ave., Sylmar, Calif.)

■ ANALOG-TO-DIGITAL CONVERTER is a single-channel system that measures d-c voltages from 3 μv to 1000 volts with accuracy of ±0.05 percent and a recording speed of 10 measurements per second. Output from the device is a paper tape punched in binary-coded decimal form for use with computers. (Systron Corp., Dept. Sci413, 950 Galindo St., Concord, Calif.)

■ DEUTERIUM ACCELERATOR TARGETS carry more than 8 ml (STP) of deuterium gas occluded in each target. Targets are produced on 1.125 in. diameter titanium film with full active area. Molybdenum is used as backing material for the 20-mg film. (Scientific Engineering Laboratories, Dept. Sci414, 1510 Sixth St., Berkeley 10, Calif.)

■ ANALOG COMPUTER for training application is said to be student-proof in the sense that no permanent damage results from incorrect programing. It is a self-contained unit with five operational amplifiers, stabilized power supplies, and patching and control facilities. Interchangeability of component assemblies permits incorporation into more complex computer installations. (Solartron Electronic Group Ltd., Dept. Sci421, 45 Thames St., Kingston, Surrey, England.)

■ TELEMETERING DECOMMUTATOR for PAM and PDM signals is said to maintain synchronization with incoming data with changes in commutation speed up to ±20 percent and over several segments of complete signal dropout. Cross talk is less than ±0.1 percent. Translators supply output of ±15 volts.

Output impedence is less than 1.0 ohm from d-c to 1000 cy/sec. Translator accuracy of ±0.07 percent is standard. Automatic zero level compensation and automatic gain compensation reduce zero shifts and full-scale shifts of ±10 percent to less than ±0.1 percent. (Telecomputing Corp., Dept. Sci422, 12838 Saticoy St., North Hollywood, Calif.)

■ BATTERY POWER PACKS consist of rechargeable nickle-cadmium battery cells potted in a plastic case for production in any size, shape, color and electrical capacity. The power packs can be specially formed to fill what may otherwise be considered dead space. The packs are hermetically sealed and are said to be shock resistant to 2000 grav. (Gulton Industries, Inc., Dept. Sci423, 212 Durham Ave., Metuchen, N.J.)

■ NOISE GENERATOR uses a 6D4 gas-discharge tube as a noise source with a magnetic field applied for stabilization. A two-stage amplifier includes noise-spectrum shaping filters selectable by panel switches. Two low-pass filters provide gradual roll-off above 30 and 500 kcy/sec, respectively. A third filter is a peaking network that compensates for the drop in output at high frequencies, so that a good spectrum can be obtained at 5 Mcy/sec. An 80-db attenuator provides metered outputs from 30 μv to 3 volts. (General Radio Co., Dept. Sci425, West Concord, Mass.)

■ MICROWAVE AMPLIFIER offers broadband amplification with gain of 30 db and 10-mw output from 10.5 to 16 Mcy/sec. The amplifier uses a permanent-magnet-focused traveling-wave tube with front-panel connector directly coupled to the tube grid. Phase modulation may be accomplished through a front-panel connector capacitively coupled to the tube helix. (Alfred Electronics, Dept Sci427, 897 Commercial St., Palo Alto, Calif.)

■ TWO-COORDINATE COMPARATOR accommodates plates and film to 10 by 10 in. with a measurable area 9 by 9 in. Range in the x-coordinate is 265 mm and in the y-coordinate is 250 mm with direct-reading accuracy said to be ±1 μ in both coordinates. Plate image and measuring mark are projected on a screen at magnification 22. The top stage of the comparator rotates through 360 deg and provides angular measurement to 20 sec by means of a vernier. Available as accessories are motor drive, analog-to-digital converts for automatic readout and film-handling devices. (David W. Mann, Inc., Dept. Sci436, Lincoln, Mass.)

■ PHOTOGRAPHIC RECORDER is a 2¼ by 2¼ in. frame camera with eight selectable frame rates up to 80/per second. The shutter is a focal-plane rotating-disc type with opening adjustable from 2 to 90 deg. A shutter synchronization pulse is provided coincident within ±1 deg with exposure 100-cy/sec pulses and an elapsed-time code for continuously running film. Registration accuracy is said to be ±0.001 in. (Benson-Lehner Corp., Dept. Sci428, 1860 Franklin St., Santa Monica, Calif.)

■ RANDOM-WAVE VIBRATION TESTING SYSTEM is designed for standardized repetitive testing and push-button operation over the frequency range 5 to 10,000 cy/sec. Peak random force is 2500 lb and peak sine-wave vector force is 1500 lb when used with the manufacturer's model A-174 shaker. No impedence changing or manual power-factor correction is required over the specified range. (Ling Electronics Inc., Dept. Sci424, Culver City, Calif.)

■ NOISE SOURCE uses a restrictive element heated to 2200°K to generate sufficient noise power to permit noise-figure measurements to 10 db. Nominal available noise temperature from 2000° to 2400°K can be read on a panel meter with accuracy said to be ±2 percent. A single tuning element furnishes a fixed range of 2 to 500 Mcy/sec or may be tuned to extend the range to 1000 Mcy/sec. An interchangeable noise head extends the range downward to 1 kcy/sec. (Kay Electric Co., Dept. Sci426, Maple Ave., Pine Brook, N.J.)

■ ANALOG COMPUTER is designed to solve Fourier integrals especially for application to determination of far fields of antennas. Amplitude and phase input functions are plotted on graph paper for presentation to the computer. The functions are read photoelectrically, passed through a pulse-position-to-voltage converter and then to computing circuitry. Integration can be observed on a d-c oscilloscope or can be recorded by accessory equipment available from the manufacturer. (Scientific-Atlanta Inc., Dept Sci433, Atlanta, Ga.)

■ DIGITAL CLOCK provides time data for each second of the day through multiple relay contacts that can be wired to produce several staircase and decimal outputs simultaneously, or a binary-coded-decimal output. An in-line display with 1 sec resolution to 24 hr is also provided. Time information may be recorded on demand. A memory circuit holds the time display up to 0.9 sec for completion of external recording so that

the record shows the exact time at which data was taken. Operation is from an external 1-sec pulse train or an optional internal line-frequency divider or crystal-controlled time base. (Dymec Division of Hewlett-Packard Co., Dept. Sci459, 395 Page Mill Rd., Palo Alto, Calif.)

■ MANIPULATOR for moving objects in vacuum or in controlled atmospheres uses double-pumped vacuum seals to permit operation to pressures as low as 10^{-6} mm-Hg. The 3-ft, stainless-steel shaft of the device can be moved in and out of the chamber and rotated and can be turned through a 90 deg cone. Positive acting parallel jaws are controlled by a pistol-grip handle. (Scientific Engineering Laboratories, Inc., Dept. Sci-416, 1510 Sixth St., Berkeley 10, Calif.)

■ SHIELDING CONTAINERS are fillable, hollow blocks of Fiberglas construction that can be filled in place with fluid or semifluid shielding materials. Two basic sizes and three compound sizes are offered. The compound blocks interlock to prevent radiation leakage. (General Nuclear Corp., Dept Sci419, 5506 Connecticut Ave., NW, Washington 15, D.C.)

■ JERKMETER is available to measure rate-of-change of linear and angular acceleration. Models are available with full-scale acceleration ranges from ±1 to ±30 grav and with full-scale jerk ranges from ±0.5 to ±20 grav/sec. Full-scale output is ±7.5 volts d-c. Resolution, linearity, and hysteresis are said to be 0.1 percent or better and accuracy to be ±0.1 percent. (Donner Scientific Co., Dept Sci432, Concord, Calif.)

■ TORQUE GAGE is a hand-held device available in clockwise, counterclockwise, or bidirectional models in ranges from 0.005 to 40 oz-in. and 2 to 2400 gm-cm. Shift diameters up to ¼ in. are accommodated. The device retains the maximum torque reading. Accuracy is said to be ±5 percent with ±2 percent accuracy available on special order. (Waters Manufacturing Co., Inc., Dept. Sci434, Wayland, Mass.)

■ ACOUSTIC NOISE GENERATOR uses an electromechanical transducer of moving-coil type to produce 163 ± 3 db of random noise and up to 170 db at discrete frequencies. Higher output may be obtained for limited periods with attendant risk of damage. Quickly interchangeable parts are a feature of the design. Frequency range is 20 to 2100 cy/sec. Random noise input power is 3 kw. Nominal impedance is 1 ohm. (Avco Research and Advanced Development Div., Dept. Sci440, 201 Lowell St., Wilmington, Mass.)

■ ALUMINUM WIRE for use at high temperatures in nuclear-radiation environments is boron-free and is insulated with boron-free ceramic. The wire is designed for continuous operation at 1000°F. Voltage rating is 400 volts and insulation resistance at 1000°F is 1.4×10^7 ohm. The wire is flexible enough to be wound around a mandrel five times its own diameter. (Technical Industries Corp., Dept. Sci439, 389 North Fair Oaks Ave., Pasadena, Calif.)

■ ULTRAMICRO ANALYTICAL SYSTEM employs liquid reagents contained in a series of squeeze bottles, each fitted with a calibrated polyethylene tip that serves as a pipette. The precise amount of reagent for analysis is added simply by squeezing the bottle. The complete system consists of a miniature spectrocolorimeter, a microtitrator, a centrifuge, and sets of reagents for specific clinical tests. (Spinco Div., Beckman Instruments Inc., Dept. Sci444, Stanford Industrial Park, Palo Alto, Calif.)

■ WIRE STRIPPER uses parallel heating elements to sever insulation for removal, leaving the wire free of nicks or cuts. Heat is adjustable for high- or low-melting materials. A single model strips wire larger than 12 AWG and smaller than 36 AWG. The tool may be hand held or used as a bench tool. (Western Electric Products Co., Dept. Sci445, 655 Colman St., Altadena, Calif.)

■ TENSILE TESTING INSTRUMENT is designed for use in hot cells for studying physical properties of irradiated materials. The straining unit is located within the cell while controls are operated outside. Full-scale range is adjustable from 2 gm to 10,000 lb. Remote operation is provided for grips, calibration, speed change, extensometer, and selection of load range. (Instron Engineering Corp., Dept. Sci446, 2500 Washington St., Canton, Mass.)

■ PORTABLE SPECTROSCOPE displays side by side spectra of an unknown solution and of a reference solution. Wavelength is read to ±5 A on a projected scale. Dispersion element is a replica grating ruled 31,070 lines/in. Dispersion is 55 A/mm. Lines as close as 3 A are said to be resolved. Sample tubes are enclosed in water jackets and sealed by lucite plugs carrying pairs of platinum electrodes. Operation is on 115-volt, 60-cy/sec power with maximum consumption 250 watts. (Fisher Scientific Co., Dept. Sci458, 717 Forbes St., Pittsburgh 19, Pa.)

■ MAGNETIC-TAPE SEARCH UNIT compares the timing or index track of a magnetic tape with switches set to designate the beginning and end of tape sections of interest. Upon location of

these sections, control signals are generated to effect printout or other desired action. The unit is composed of transistorized plug-in modules. (Vitro Laboratories, Dept. Sci443, 200 Pleasant Valley Way, West Orange, N.J.)

■ TRUE AIR-SPEED COMPUTER consists of a force-balance Mach transducer, a platinum-resistance temperature sensor, passive resistance network, and a follow-up servo. Three operating ranges and accuracies for various applications are available. (Servomechanisms, Inc., Dept. Sci430, 12500 Aviation Blvd., Hawthorne, Calif.)

■ BOTTOM-FILLING ATTACHMENT for automatic filling machine eliminates or minimizes foaming, permitting faster filling. With the attachment, filling nozzles are automatically lowered into the containers and are raised, as the liquid level rises, at a rate that may be adjusted to coincidence with the filling rate. (National Instrument Co., Inc., Dept. Sci454, 2701 Rockwood Ave., Baltimore, Md.)

■ GAMMA-RAY SENSITOMETER uses cobalt-60 foil to give industrial x-ray film controlled exposure in tests of sensitivity. Elevators bring the film samples in cassettes into position for exposure in the lead chamber in which the sources are stored. Four sources of different radiation activities are used. (Eastman Kodak Co., Dept. Sci441, Rochester, N.Y.)

■ WIND TUNNEL is a portable model designed especially for educational application. In operation, the tunnel uses a 2500-lb/in.^{2} dry-gas source with running time as high as 4 minutes from a standard 2-ft^3 nitrogen cylinder. Continuous adjustment in the range Mach 1 to 4 is provided. Wind-tunnel and free-jet test section configurations are interchangeable. A schlieren system is provided for visualization of flow phenomena. Its 4-in. square groundglass screen can be photographed without special camera equipment. An inlet air heater that eliminates ambient moisture condensation is thermostatically controlled. Operation is on 115 volts a-c. (Amrad Inc., Dept. Sci456, Box 254, Sewanee, Tenn.)

■ TORQUE PICKUPS are available for full-scale ranges from 50 to 250 in.-oz full scale with useful speed ranges up to 10,000 rev/min. Full-scale output is 2 mv/volt. Thermoelectric voltages are said to be less than 2 μv peak-to-peak, at 10,000 rev/min. (Lebow Associates, Dept. Sci431, 941 West Warren, Detroit, Mich.)

■ RIPPLE TANK provides projected images of wave crests and troughs 6 to 8 ft in diameter. Bottom of the tank is a 3.5-in. condenser lens. A built-in variable speed stroboscopic interrupter permits phenomena to be displayed in motion, slow motion, or at rest. (Ealing Corp., Dept. Sci437, 40 University Rd., Cambridge, Mass.)

■ MECHANICAL PRESSURE-VACUUM PUMP is a compact unit weighing 5 lb, including its motor. The pump has a free-air capacity of 0.3 ft^3/min and will produce 17 in.-Hg vacuum or 20 lb/in.^{2} pressure. Pumping mechanism is an aluminum piston with graphite sealing rings. (Gelman Instrument Co., Dept. Sci438, P.O. Box 86, Chelsea, Mich.)

■ HIGH-PRESSURE SYSTEM, a portable unit for testing missile components, includes a diaphragm gas compressor and a ½-ft^3 accumulator, both rated at 10,000 lb/in.^{2} gage. Compressor capacity is 4 ft^3/min, standard, at 2000 lb/in.^{2} gage. Air, nitrogen, and helium can be handled. (Pressure Products Industries, Inc., Dept. Sci442, Hatboro, Pa.)

■ STERILIZATION INDICATOR is a pressure-sensitive paper tape imprinted with a colorless chemical substance so that when subjected to a specified standard sterilizing cycle the word *sterile* ap-

pears. Activation requires an autoclaving temperature of 250°F for at least 15 minutes. Accidental activation under atmospheric conditions is said to be impossible. (Professional Tape Co., Inc., Dept. Sci453, 355 Burlington Ave., Riverside, Ill.)

■ MERCURY COLLECTOR is said to pick up individual globules of spilled mercury in the pores of a foamed-plastic pad when the latter is pressed firmly against the surface on which the mercury has been spilled. The collected mercury is released when the pad, carried in the screw lid of a container, is screwed back on the container. (Bel-Art Products, Dept. Sci448, Pequannock, N.J.)

■ POWER SUPPLY for test and measurement of infrared photoconductors is battery operated with 50, 100, 500 volt ranges. Current ranges are 25, 100, 250, 1000 μa. A microammeter and a voltmeter of ± 1 percent accuracy permit measurement of detector resistance under conditions of use. (Infrared Standards Laboratory, Dept. Sci451, 10555 Magnolia Ave., Riverside, Calif.)

■ DIFFERENTIAL-TRANSFORMER AMPLIFIER furnishes outputs suitable for driving cathode-ray oscilloscopes, pen recorders, or light-beam galvanometer recorders. Frequency response is flat from 0 to 200 cy/sec and useful to 500 cy/sec. Accuracy is said to be ± 2 percent with maximum resolution of 5 μin. of core displacement. Excitation supply is self-contained. (Daytronic Corp., Dept. Sci452, 225 S. Jefferson St., Dayton 2, Ohio)

■ RADIOMETER measures temperature of remote surfaces from 120°F upward. Area measured is typically 1 in.^{2} at a distance of 40 in.; area increases approximately as the distance. Two models are available. One has a servo drive for the null-balancing measuring system; the other is manually balanced. Either may be calibrated for emissivity of the surfaces being measured. (Williamson Development Co., Inc., Dept. Sci455, 317 Main St., West Concord, Mass.)

■ COMPLEX-RATIO BRIDGE measures in-phase and quadrature voltage ratios of three- or four-terminal networks. Frequency ranges of two models are 30 to 1000 cy/sec and 50 to 3000 cy/sec, respectively. Transformation ratios are read from digital switch dials in terms of rectangular coordinates, tangent, or phase angle. Maximum accuracy of in-phase ratio is said to be ± 0.001 percent. (Gertsch Products, Inc., Dept. Sci457, 3211 S. La Cienega Blvd., Los Angeles 16, Calif.)

JOSHUA STERN
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Letters

(*Continued from 796*)

dose and cancer incidence *in the dose range of known carcinogenicity*. The question is whether natural radiation plus fallout brings us into that range, and I see nothing in Blum's work that bears on this crucial point.

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Before answering Berg's specific criticisms may I point out that my article does not state, as he implies, that there is no threshold for radiation carcinogenesis, but only that it is infeasible to demonstrate one experimentally. As I say in that article, and elsewhere (*1*, *2*), the analysis of data on the induction of cancer by ultraviolet light suggests that a threshold exists but does not permit a value to be set for that threshold, although it must be very low. The argument in the article under discussion is based on the good agreement between extensive experimental data and a quantitative model that is compatible with the concept of acceleration of cancer growth rate under conditions of repeated dosage. Certain extrapolations are made in the article on the basis of this model, but no discussion of the experiments or the model itself was attempted in the brief space available. In objecting to my extrapolations Berg seems to disregard, or to be unaware of, the consistent agreement of the model which I use in my extrapolations with the *whole* of these data, although he cites a reference in which both data and model are discussed at length (*1*).

Although many of Berg's criticisms are directed at points in the basic structure rather than at the content of this particular article, it seems necessary to answer them here. I shall attempt to do so in more or less the order he presents them. Figure 1 in the article is based on the aforementioned model and does not purport to represent specific experiments; it was designed to illustrate the extrapolation to conditions near the end of the life span of the animals, where experiments must necessarily be untrustworthy or infeasible. Curve 1 in this figure obviously represents an extrapolation, since it refers to a time when most of the animals would have been dead. Berg seems to have taken this figure more literally than was intended, since he raises the objection that I do not have experi-

mental data for this particular curve. Citing one of the papers in which some of these data are described (*3*), Berg writes, "the third dose level is treated partly by extrapolation." Apparently Berg is referring to data taken from an experiment in which a dose level which would correspond approximately to curve 3 in Fig. 1 was used. The extrapolation in this case was to the 50-percent incidence level, from measurements representing lower incidences; this extrapolation was made for purposes of comparison, since a more complete curve could not be obtained for this dosage because of normal mortality. So the extrapolation has a better basis than might be inferred from Berg's statement. Actually, the experiments cover rather well the dosage range that it is feasible to study with the animals in question. The fact that one cannot obtain more complete coverage might in itself indicate the infeasibility of setting a threshold, since we can never be sure that cancers which have not come to detectable size before the death of the animals are not present.

Berg does not point out that the validity of the extrapolation represented in Fig. 1 rests on the finding that within the experimental range the shape and slope of the distribution curves does not change with dose or other factors; the reliability of this finding is treated in a later publication (*4*) than the one Berg cites—one which contains further data. The constancy of the incidence distribution curve is illustrated graphically in Fig. 31 of (*1*), where points obtained from over 600 mice are brought into relationship on a composite plot. The curves in Fig. 1 of the article in *Science* are based on this relationship, their positions on the abscissa corresponding to Eq. 1. An important point in the evaluation of the model is that it fits other data in which doses were interrupted (see *1*). If all these data are taken into consideration in terms of the model, I think there is ample justification for the extrapolation that is made in the article under discussion.

Berg is reproachful because studies of the earlier stages of development of cancers were not made with the microscope. But has he taken into consideration the quantitative aspects of such a study? In our experiment the end point was the gross appearance of a tumor of a given volume. Obviously, it would be a great advantage to have reliable data on the growth at earlier, microscopic stages if it were feasible to obtain them. But the time of tumor appearance varies widely among the animals of an identically treated population (see Fig. 1), and one does not know in advance which animal is going to be the first to display a tumor, or how to place any of the animals in

order with respect to the time at which a tumor will appear. We thus face a dilemma; if we wait until a tumor appears we have no measurements of microscopic stages; on the other hand, if we sacrifice the animal before a tumor appears we can have no idea when the tumor would have become microscopically observable had the animal been allowed to survive. If we attempt successive biopsies we are certain to interfere with tumor development, and besides we would not know where to make them. Gross observation shows that more than one tumor may develop on the irradiated area, and that the tumor we ultimately measure is the one of these that grows the fastest (for example, see Fig. 50 in *1*). It is also to be noted that good many of the tumors are mixed (sarcoma and carcinoma), indicating more than one site of origin (*5*). Altogether, the attempt to search out the course of tumor development by microscopic study would seem to have somewhat the aspect of a search for a needle in a haystack.

The decision as to whether it would be advisable to attempt microscopic studies at all—for Berg would apparently attempt them in spite of these difficulties—must depend upon extrapolation back from the time of appearance of tumors. The extrapolation must depend upon the kind of mathematical model one uses. Berg reaches the conclusion that such a study should have been made by means of an extrapolation; this extrapolation, though vaguely stated, would seem to be based on the idea that the tumor has been growing for some time at a constant relative rate. Berg uses the estimates of terminal growth rate which I have made; but if he will examine the original article in which these rate measurements are described (*6*) I think he will find ample indication of the uncertainties involved in such an extrapolation and of its obvious inapplicability. Moreover, the model which we have found to describe the data indicates an acceleration of the relative growth rate of the tumor, in which case the measured terminal rate could not be a valid index of growth at earlier stages when growth must have been slower. From the model it appears that although one may essay to extrapolate to the initial volume at the time the first dose of radiation is given (*1, 7*), extrapolation to intermediate volumes is not possible without information we do not have (*1, 8*).

Berg attempts to demonstrate the existence of a threshold for ultraviolet carcinogenesis on the basis of an interpretation of certain of my data from experiments in which the doses of ultraviolet light were interrupted. He apparently obtained his data by interpolation in curves published in an article about

10 years ago (*9*) in which an approximate model for accelerated growth of these tumors was first developed. It was pointed out that the model as therein developed could account for certain aspects of the data but not for the data of these particular experiments with interrupted dosage. Since that time we have modified the model, without abandoning its essential form, to obtain a model which accounts satisfactorily for *all* these data. Apparently Berg has not consulted Figs. 45 and 47 in (*1*), since he would have found there that all the experimental points fit very well with the new model, and that this renders the calculation he has made quite meaningless. The curves as they stand suggest, although not unequivocally, that there is a slight amount of "recovery" in early stages, which would imply a threshold but certainly at a very low level. As I have said, however, I do not deny in the article the existence of a threshold for radiation carcinogenesis but hold that experimental demonstration of such a threshold is infeasible. I think that a careful consideration of the quantitative aspects of the data and the problem of carcinogenesis will lead others to the same conclusion in this regard that I have reached.

But perhaps Berg has a different concept of threshold than I have, since he writes, "if the first cancers are not to appear until after all the animals are dead, we have a practical threshold if not a biologic one." I must confess that the distinction between a practical and a biologic threshold puzzles me. It is to be noted that normal distribution curves such as those that describe the time of appearance of tumors (see Figs. 1 and 2) are not extrapolable to zero incidence, and the probability of a tumor appearing within such a population at any given time must depend, among other things, upon the size of the population. In such case I cannot see how the failure to observe cancer in a population of, say, 1000 mice within their life span of 1 or 2 years can tell us much about a threshold, in say, the 180 million human beings in the United States with a life expectancy of three score and ten years.

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Strontium-90 from Fallout

In two letters in *Science* (*1*, *2*) reference was made to our work described in *Bone and Radiostrontium* (*3*).

Commoner (*1*) states that a contradiction exists between our finding "that microscopic regions of the bone may receive a radiation dose about 40 times the average" and the heterogeneity factor of 5 suggested in the U.N. report (*4*). This is not necessarily a contradiction, for our figure is applicable to acute intake conditions, while the U.N. report considers intake over a number of years. That the existence of chronic intake conditions decreases the heterogeneity of the strontium distribution has already been pointed out (see, for example, *5* and *6*). In addition, it might be pointed out that the method of calculation used by Eisenbud (*7*) and criticized by Commoner (*1*) is correct in our opinion. It is, according to the U.N. report (*4*, p. 42, Table 2, note *c*), sufficient to consider the average dose if the corresponding maximum dose does not exceed the average by a factor of more than 80.

Kaplan (*2*) takes our recommendation of 0.1 μc of Sr^{90} as the body burden after acute intake and applies it directly to the fallout situation. This is not in correspondence with the view expressed in (*5*): [The Sr^{90} contamination] "corresponds to a situation with aspects that lie somewhere between those of acute and chronic Sr^{90} poisoning. Children in the 0- to 5-year age group are examples of individuals with chronic poisoning conditions. Adults above 20 years of age are more likely to be examples of acute poisoning."

A figure of 0.0001 μc of Sr^{90} per gram as a level at which bone cancers were produced in dogs was cited in *Bone and Radiostrontium* (*3*) and cited again by Kaplan. This figure refers to radiothorium, however, and not to Sr^{90}. Although the figure cited is much too low in comparison with other experimental data, it seems to have caused confusion in the discussion of the biological effects of Sr^{90}, and this we sincerely regret.

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"Next Question" and K. E. Tsiolkovsky

The editorial "Next question" [*Science* **130**, 1733 (25 Dec. 1959)] on attempts to pick up possible radio signals from the nearest stars (the project directed by Frank D. Drake) reminded me of analogous thoughts of Konstantin E. Tsiolkovsky, a Russian pioneer in rocketry. Tsiolkovsky's name is now well known to the American scientific public. His book *Exploration of Space by means of Reactive Apparatus* was published in Russia in 1896, and his name was given to one of the craters on the far side of the moon. In his little book *Monism of the Universe*, published many years ago in Kaluga, Russia, as well as in his letters to me (1933–35), he postulated the existence of highly developed intellectual societies in other worlds. Tsiolkovsky suggested, also, that such beings colonized many other planets by means of interstellar ships, painlessly destroying the products of unsuccessful biological evolution on other planetary bodies. The main objective of these intelligent beings is probably "humane colonization versus painful evolution," the evolutionary

process being left alone on some planets for the purpose of "biological refreshing" only, Tsiolkovsky said. In another booklet, *The Unknown Intelligent Forces,* also in Russian, he wrote that those "others" probably have not yet tried to communicate with earth or with other bodies in our solar system because we are still not prepared for this. Such a communication would create confusion and panic in our society, and it is probable that the "others" have decided to wait for our signals.

I must add that these speculations of K. E. Tsiolkovsky have not been praised highly by the Soviet Government, for they are considered groundless and antimaterialistic. The authorities in Moscow could not touch Tsiolkovsky himself, because of his fame and popularity, but his secretary lost his job. The book *Monism of the Universe* ends with 14 corollary "R.M.S. theses" ("R.M.S." stands for *razvye mozhno somnyevatsya,* meaning, "can one doubt that . . ."), which repeat briefly the main conclusions and are very optimistic in tone.

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Scientific Nomenclature

I have long been disturbed by the unscientific character of scientific nomenclature. In all the sciences nomenclature has grown up by a succession of historic accidents. Ideally the name of anything should convey as much information about the object as possible. In most sciences the names of things convey hardly anything in themselves, and any connotation which they have has to be painfully learned. Even where the name of a scientific object has some relation to it, the connotation frequently reflects some accidental property or obsolete theory. It is true, in a way, that hydrogen generates water, as men generate babies, though this may not be its most important property. The connection of tellurium with the earth or of selenium with the moon is obscure.

Fortunately most scientists are unacquainted with the dead languages from which their nomenclature is largely drawn, and so scientific names generally convey merely zero, rather than negative, information. Fortunately, also, physics and chemistry have few enough objects of study so that the learning of a set of arbitrary names is not a hopelessly burdensome task. In biology the problem is very serious but probably hopeless. Biological nomenclature is such a hopeless and vast hodgepodge of historical, geographical, and personal accidents that one despairs of ever reducing it to the slightest semblance of rationality, especially as the objects themselves seem to be the result of a hodgepodge of historical accidents also.

There is one field, however, where the objects of study have a nice rationality of *position* which makes possible a scientific nomenclature in which the name given to an object could be rich with information about it. This is astronomy. Like that of other sciences, astronomical nomenclature is a random historical mishmash of Greek, Arabic, and modern components. The name *Sirius* tells us even less about Sirius than the name *hydrogen* does about hydrogen. Star catalogs are a hopeless potpourri of letters and numbers obeying little or no rational principle. It is possible, however, to devise a system of star nomenclature whereby the name of any star would give in itself most of the essential information about it, so that, given the name, one could immediately deduce the position and properties of the star, or given its position and properties, immediately attach a name to it. It would probably be most rational to reform also the ancient method of counting degrees in sixties, and to go straight to a binary system of numbers. But this is perhaps too radical. Let us accept, therefore, the traditical definition of position in terms of degrees of right ascension and declination, or heavenly latitude and longtitude. There are 360 degrees around the celestial equator. There are 19 usable consonants in the Roman alphabet, if we exclude *q* and *x*, which cannot be used to begin syllables. By a providential accident, 19 × 19 is 361. Two consonants, therefore, will define a degree of right ascension, in the scale of 19. Suppose we number the consonants as follows:

b	c	d	f	g	h	j	k	l	m
0	1	2	3	4	5	6	7	8	9

n	p	r	s	t	v	w	y	z
10	11	12	13	14	15	16	17	18

I grant that the roman alphabet and the languages spelled in it are also in sad need of reform, but here again one reform at a time is probably enough. We can now express any number up to 360 as an ordered pair of consonants. Thus, 0 would be *b,b*; 100 (5 × 19 + 5) would be *h,h*; 200 (10 × 19 + 10) would be *n,n*; 291 (15 × 19 + 6) would be *v,j*. We only need 180° for the declinations, so we might use the first 180 pairs, or start with *b,b* at the South Pole, reaching *g,t* at the equator and *m,m* at the North Pole. We may note that translation from the scale of 19 consonants to the scale of 10 digits is very easy because every double consonant is a multiple of 20. Four consonants in order

now give us the location of any star to within a square degree. We can now use the vowels to indicate other properties. The five vowels (*a, e, i, o, u*) with the 25 diphthongs (*aa, ea, ia,*—down to *ou, uu*) give us plenty of scope and can be numbered in order, giving us 30 possible vowels for each place. Thus, the first vowel could indicate the integer of magnitude; the second vowel, the first decimal of magnitude; the third vowel, color; the fourth vowel, spectral type, or whatever some distinguished international committee of astronomers decided was most important.

With a single name of four consonants we can name one star in each square degree. This gives us 64,800 names—adequate to name unequivocally all stars visible to the naked eye and even well beyond. There may be a few cases, in star clusters like the Pleiades, where a square degree has more than one star visible to the naked eye, but these must be rare. Then, by adding another similar name to the "surname" we can identify 360 × 360 or 129,600 stars per square degree, or over 9 billion in all. This names every square 10 seconds of the sky, which is probably enough for most astronomers. If necessary, a third name would cover all conceivable cases. The names are apt to sound a little Japanese or Italian, but this is surely a small sacrifice on the altar of a world science. Sirius perhaps sounds a little uncouth as Zacafawe, Capella as Gadakugo, and Polaris as Bevamoli, but no doubt the ancient names could be retained for those who wanted to use them, and, as most stars have no names anyway, there would be no fine old traditions to stand in the way of their semantic baptism.

While I am on the subject of reform, having been a binarist from the word *bit*, let me suggest a simple method for saying the binary numbers. I say "saying" rather than "naming" because I do not really approve of naming numbers anyway, any more than I approve of gilding lilies. Even in the decimal system it seems to me foolish to *name* the perfectly good number one-nine-six-oh, or even, in a fit of centesimalism, nineteen-sixty, under the laborious title "one thousand nine hundred and sixty." Attempts to *name* the binary numbers end up in hopeless clumsiness and cacophony. On the othe hand it is perfectly easy to *say* the binary numbers if we adopt one conventional symbol for "1" and another for "0." I have toyed with "Bim" for 1 and "Bam" for 0, in which case we would count: Bim, Bimbam, Bimbim, Bimbambam, Bimbambim, Bimbimbam, Bimbimbim, Bimbambambam, and so on. If this sounds too sonorous I am prepared to compromise on "Bit" (for 1) and "te" (for 0), in which case we count Bit, Bitte, Bitbit, Bittete, Bittebit, Bitbitte, Bitbitbit, Bittetete, and so on. I may point out that (to look a few years ahead) Bitbitbittebittebitbitbitbit has no more syllables in it than "one thousand nine hundred and sixty-seven." I have little doubt, however, that the fact that even scientists have ten fingers will tie the human race to a wholly arbitrary decimalism for many centuries to come.

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Tax Exemption and Research

In the 1 January issue of *Science* [**131**, 7 (1960)] appears the editorial entitled "Tax exempt." I am sure you would be among the first to concede that the tax treatment of scientific research is a subject far too complex to be covered adequately in the single page of an editorial. Nevertheless, the subject is also too important to be dismissed lightly; and to a society having as its purpose the *advancement* of science, proposals to tax research have far-reaching implications that deserve more extensive attention than is given by your short article.

Some statements in your editorial are contrary to fact. The newly proposed

regulations do *not* say that an organization to be exempt must "be operated primarily for fundamental research," as stated in your editorial. The Internal Revenue Service has apparently had the wisdom to see that the dividing line between "basic," "fundamental," and "applied" research is something that scientists themselves do not agree on, and to see that it does not provide a proper basis for taxation.

The newly proposed regulations do set forth as a test of whether research is "scientific" that the results of such research must be made freely available to the public. This strikes me as a curious definition of the term *scientific*, since it makes the method of dissemination rather than the scientific nature or content of the research the test of whether the research is scientific. Of course, the significance of this definition of *scientific*, as stated in the new proposed regulations, turns on what is meant by the "freely available" test. The proposed regulations seem to intend to limit this test by a concept which sets as the standard that the research is directed not toward promoting private gain but rather toward benefiting the public.

There is a shocking fallacy implicit in a concept which places private gain in opposition to public benefit. The economic and political system of this country is founded on the principle that there are public benefits from the opportunities for private gain. Certainly the public is benefited where the opportunity for private gain leads to the promotion or support of scientific research. As I understand it, all that the tax laws require as a qualification for exemption from tax is that the net earnings of an exempt organization should not inure as a private gain to the members of the exempt organization; but the fact that research leads to someone else's private gain (that is, gain for industry and, in fact, for the public itself) does not mean that research is directed any the less toward benefiting the public.

The concept expressed in the regulations goes to the root of other tax exemptions. The editorial itself points to the danger and inconsistency in the proposed regulations in this regard. In indicating which organizations will be affected or not affected by the regulations, the editorial points out, for example, that universities will not be affected, and in this connection you state that their exemption includes "income derived from applied research that is not available to the public." At the same time the editorial indicates that independent research institutions carrying on the same activities will be affected. If such activities are not in the public interest when conducted in such institutions, will not this conclusion strike at the basis for exemption for all other organizations conducting research? If science itself is found unworthy of the protection of tax-exempt status because private gain may be derived from the application of scientific research, then neither education nor any other purpose will long provide an effective tax screen, for the conduct of research in any institution would then inevitably be considered to be in the domain of taxable business enterprise. I am sure that the American Association for the Advancement of Science cannot remain indifferent to this prospect.

The proposed regulations raise another fundamental question that the association may very well want to ponder. As pointed out in the editorial, under the proposed regulations any research done for a government agency would be considered of an exempt character, but research conducted for industrial sponsors would generally not be. This would make the course of future research organizations dependent upon government programs and would require that they primarily serve government agencies as a price for tax exemption. The freedom heretofore enjoyed of pursuing scientific research in the interest of increasing scientific knowledge, regardless of who sponsors the research, would be lost, and in its place would be the necessity of committing the institution to the mercy of government programs in order to maintain tax-exempt status. This loss of scientific freedom poses a question of great importance for those interested in the advancement of science in a free society.

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The proposed regulation is, indeed, complex; but with reference to the question of fundamental research it has this to say: ". . . for purposes of the exclusion from unrelated business taxable income provided by section 512(b)(9), it is necessary to determine whether the organization is operated primarily for purposes of carrying on 'fundamental,' as contrasted with 'applied' research." —ED.

Population Control by Release of Irradiated Males

The article by E. F. Knipling in *Science* [**130**, 902 (1959)] on possible methods of insect control by treatment of males with radiation or chemicals is interesting and illuminating. It should be pointed out, however, that where males are irradiated and released in the field, the restriction of monogamy in females of a species is not a requirement for

controlling population size, since sterility of the males (*sensu stricto*) is not necessarily the radiation effect which causes the population decline. Even with multiple matings by every female, the population collapse would be as inevitable and rapid as when the females are monogamous.

The effect of radiation which probably is most important is the induction of dominant lethality in the sperm, not male sterility. For illustration, let us consider an insect population made up of ten males and ten virgin females. Ninety irradiated males are introduced into this population. The females mate only once. When perfect randomness is assumed in this simple example, the probability exists that nine of the females will mate with irradiated males and produce no viable offspring, and that one will mate with a normal male and produce normal offspring. One hundred percent of the eggs from one female and 10 percent of the total batch of eggs will survive. In this case, it will not matter whether dominant lethals are induced in the sperm or the males are made sterile.

Now consider the same conditions, but let every female mate ten times. Each female will mate with ten males, nine of which contain dominant lethals and one of which has normal sperm. Ten percent of the eggs from each female and 10 percent of the total batch will survive; this is in accord with the rule of strict monogamy, even though polygamy is the case here. If the irradiated males are sterile, 100 percent of the total batch of eggs survive.

It is obvious that, if the primary action of radiation is that of inducing dominant lethality in the sperm, the results are identical whether female monogamy or promiscuity obtains. In practice, one of course can imagine circumstances whereby monogamy or polygamy could influence the rate of decline, and according to the circumstances, polygamy actually could be an advantage for population collapse.

It is generally known that at levels of radiation of about 10 kiloroentgens to either the fly *Drosophila* or the wasp *Habrobracon*, dominant lethal events are induced in over 99 percent of the sperm. However, to obtain complete killing of the sperm, radiation levels of about 200 kr are required [for observations on *Habrobracon*, see Whiting and von Borstel, *Genetics* **39**, 317 (1954)]. It has been observed in *Drosophila* that dominant lethals are induced in mature sperm and spermatocytes in later stages of spermatogenesis, and that after these are exhausted a period of sterility sets in, from which, at doses of about 10 kr, the flies never recover [see Welshons and Russell, *Proc. Natl. Acad. Sci. U.S.*

43, 608 (1957)]. The process of sperm exhaustion following irradiation requires about a week of continuous multiple matings, but *Drosophila* males that have not been mated for 19 days after irradiation still have sperm reserves containing dominant lethals [Demerec and Kaufmann, *Am. Naturalist* **75**, 366 (1941)]. With the simple cytological procedures now available for determining, at different doses of radiation, the components of dominant lethality [von Borstel and Rekemeyer, *Genetics*, in press] and sterility [Welshons and Russell, *Proc. Natl. Acad. Sci. U.S.* **43**, 608 (1957)], there should be little difficulty in determining dose-effect relations for any insect.

Knipling pointed out in an earlier paper [*J. Econ. Entomol.* **48**, 459 (1955)] that competition of sperm from irradiated males with that of normal males can replace strict monogamy as a prerequisite for success of the irradiated-male technique for eradicating insect populations. He also quoted the observation of Bushland and Hopkins [*J. Econ. Entomol.* **46**, 648 (1953)] that fertilization of eggs by irradiated *Callitroga* males occurred in the screwworm experiment. Death of the *Callitroga* embryos must have been through induced dominant lethality in the studies of Bushland and Hopkins. Admittedly, if monogamy is the rule, dominant lethality and sterility are equally effective, but the two effects of radiation must be neither lumped nor confused. By a curious historical quirk, the dominant-lethality concept was completely shadowed by the well-executed and dramatic experiments of Baumhover and his associates [*J. Econ. Entomol.* **48**, 462 (1955)] in eradicating the screwworm from Curaçao, since *Callitroga* apparently mates once. Since the males were irradiated as early pupae, it is possible that both dominant lethality and true sterility were contributing factors to the success in Curaçao and the recent success in Florida of efforts to eradicate the screwworm.

The reason for again drawing attention to the feature of dominant lethality induced by radiation is that the restriction of monogamy has been fixed in the minds of many entomologists with whom I have discussed this problem. Also, the author of a theoretical discussion on the eradication of the tsetse fly [Simpson, *Biometrics* **14**, 159 (1958)] is concerned about the monogamous restriction, since Nash [*Bull. Entomol. Research* **46**, 357 (1955)] has evidence that multiple matings take place in the tsetse fly.

With the potential of the induced-dominant-lethality method for insect eradication barely explored, and since with radiation the dosage can be con-