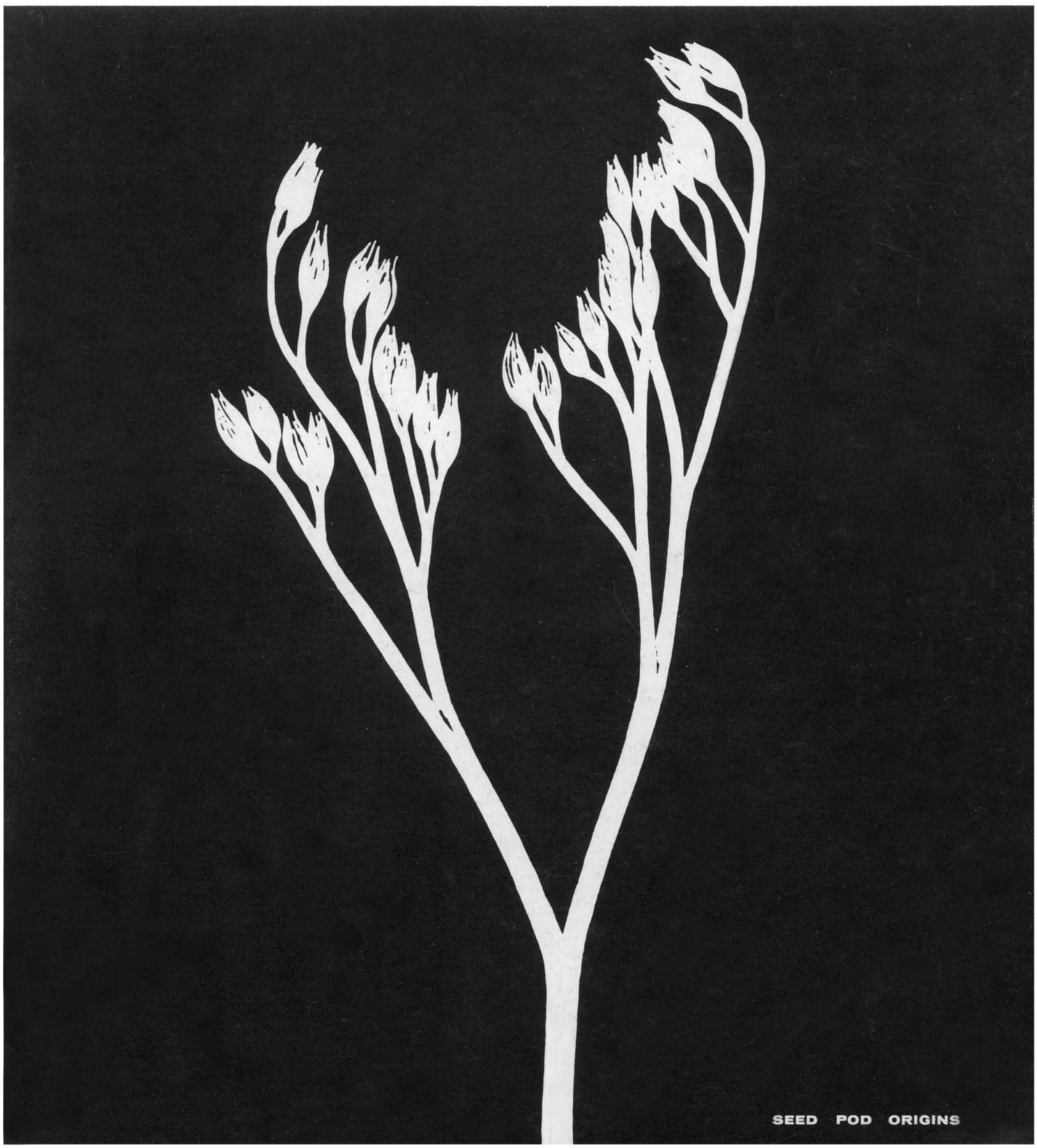
SCIENCE

15 November 1963

Vol. 142, No. 3594

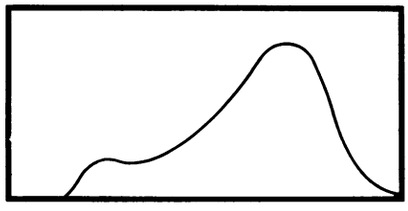
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



The Analytical Ultracentrifuge... *a review of some exciting new measurements*

The Analytical Ultracentrifuge has come a long way from its early days of simply photographing molecules as they sediment in high force fields. It now provides many of the highly sophisticated measurements needed in such rapidly advancing disciplines as biochemistry, biophysics, genetics and polymer chemistry. Three measurement areas are particularly active.

Interacting Systems The analysis of systems containing interacting components is the focus of considerable theoretical interest. An important contribution has been Gilbert's theory for reversibly interacting systems involving a single component. Systems of two components which react to form a complex also have been studied in detail. Bethune and

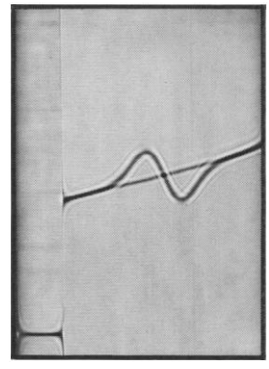


Monomer-Trimer Equilibrium Forms Two Boundaries

Kegeles have applied a computer to analyze these systems as well as systems involving polymerization. Townend, Timasheff and co-workers have studied molecules which associate in aggregates as large as pentamers, and dissociate into sub-units. Others have examined isomerizing systems in which molecular interactions occur at speeds comparable to the time of separation of the molecular species. Both sedimentation and electrophoresis have provided important measurements in these studies.

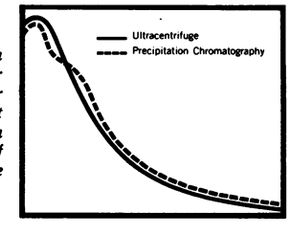
Density Gradients Now established as a powerful and sensitive method to study nucleic acids, equilibrium sedimentation in a density gradient is rapidly finding other uses. Ifft and Vinograd have used density gradients to calculate molecular weights for solvated macromolecules, and have studied in detail the behavior of a protein of known molecular weight in a density gradient. Hu, Bock and Halvorson through use of stable isotopes have distinguished between newly synthesized and pre-existing proteins in a cell-free system. Wales has used density gradients of organic solvents to study extremely small quantities of various synthetic polymers, and Hermans has used density gradients to analyze for molecular weight distribution and density distribution of polymers. Both the analytical ultracentrifuge with ultraviolet and schlieren optics, and the preparative unit with swinging bucket rotors are widely used in density gradient centrifugation.

Schlieren Pattern of BMA at Sedimentation Equilibrium in a Density Gradient



Synthetic Polymers The two density gradient studies noted above are only part of the recent surge of research using the ultracentrifuge to study synthetic polymers in organic solvents. Important papers have been published by investigators at the National Bureau of Standards, Esso, Shell Development, Dow, and Chemstrand. Their work covers linear polyethylene, polystyrene, Hevea rubber, and cis-1, 4-polyisoprene. A particularly significant example is the study by Wales and Rehfeld showing excellent results in measuring molecular weight distributions from sedimentation velocity data, and demonstrating clearly that their method did not require calibration with fractions of known molecular weight.

Comparison of Data for Molecular Weight Distribution of Polystyrene



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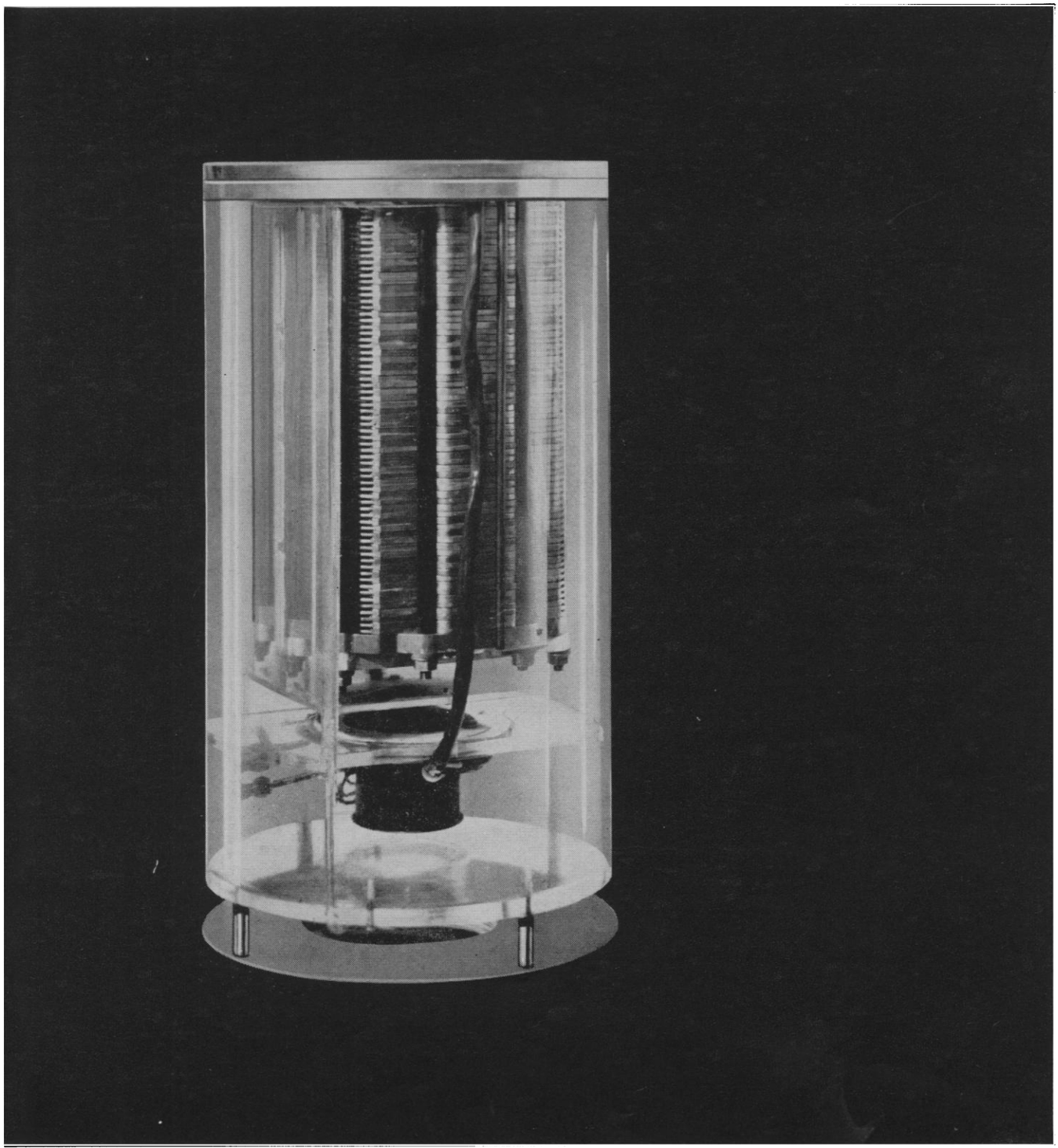
COVER

Restoration of a segment of an early, primitive seed plant. The frond fragment has paired terminal cupules. Each cupule, which partially enclosed one or two seeds, may represent an early stage in the evolution of the seed pod of flowering plants. [From the work of Albert G. Long in *Transactions of the Royal Society of Edinburgh*] See page 925.

for space power



What's so different about the Vanguard Model 1000 volumatic fraction collector?

A Only the Vanguard Model 1000 Volumatic Fraction Collector is completely transistorized, completely self-contained. Thanks to transistorization, you're assured of absolute reliability in performance. This reliability even extends to cold-room environments where temperature often causes erratic operation or complete instrument failure.

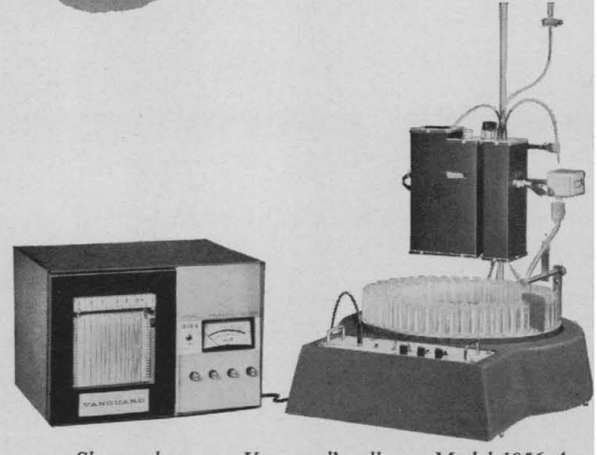
Q. How does the Vanguard Volumatic Fraction Collector affect hold-up and mixing?
A. In volumetrically controlled separations, hold-up and mixing are virtually eliminated between fractions.

Q. How is this reduction possible?
A. The Model 1000 uses a unique system of repetitive cuts for a single sample, in conjunction with a photo-electric sensing device. It actually collects from one to ten times the siphon volume in each test tube. You simply dial the number of times you want the siphon filled and discharged into each test tube.

Q. Is the Model 1000 compact and portable?
A. Vanguard's Model 1000 is highly compact. Specifically: 25″ wide, 30″ long and 6″ high. So, you make maximum use of laboratory and cold-room space. The Volumatic weighs less than 50 lbs. Yet, because the instrument cabinet is cast aluminum, you get the strength and rigidity needed for large columns and ancillary equipment.

Q. Any other facts?
A. Interchangeable turntables for 13mm, 15mm and 18mm test tubes are standard accessories. There's a complete selection of siphons. For increased versatility, a time and drop counting plug-in unit is available.

Q. Where can I get more information?
A. For complete information about the Model 1000, write: Vanguard Instrument Company, Box 244, LaGrange, Illinois.



Shown above are Vanguard's all new Model 1056-A Automatic UV Analyzer and Model 1000 Volumatic Fraction Collector.

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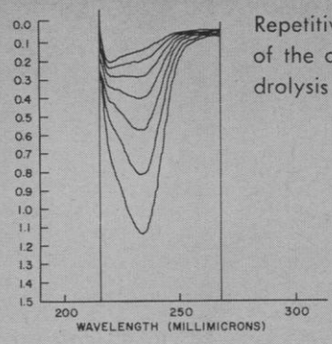
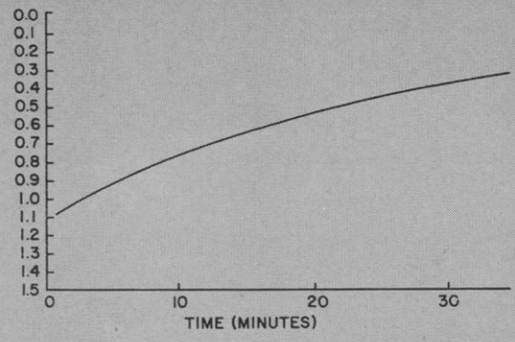


Repetitive scans at 10-minute intervals of the changes produced by the hydrolysis of glutethimide in KOH.

Time vs. absorbance analysis of the same hydrolysis, performed on a Model 202 with Time Drive.



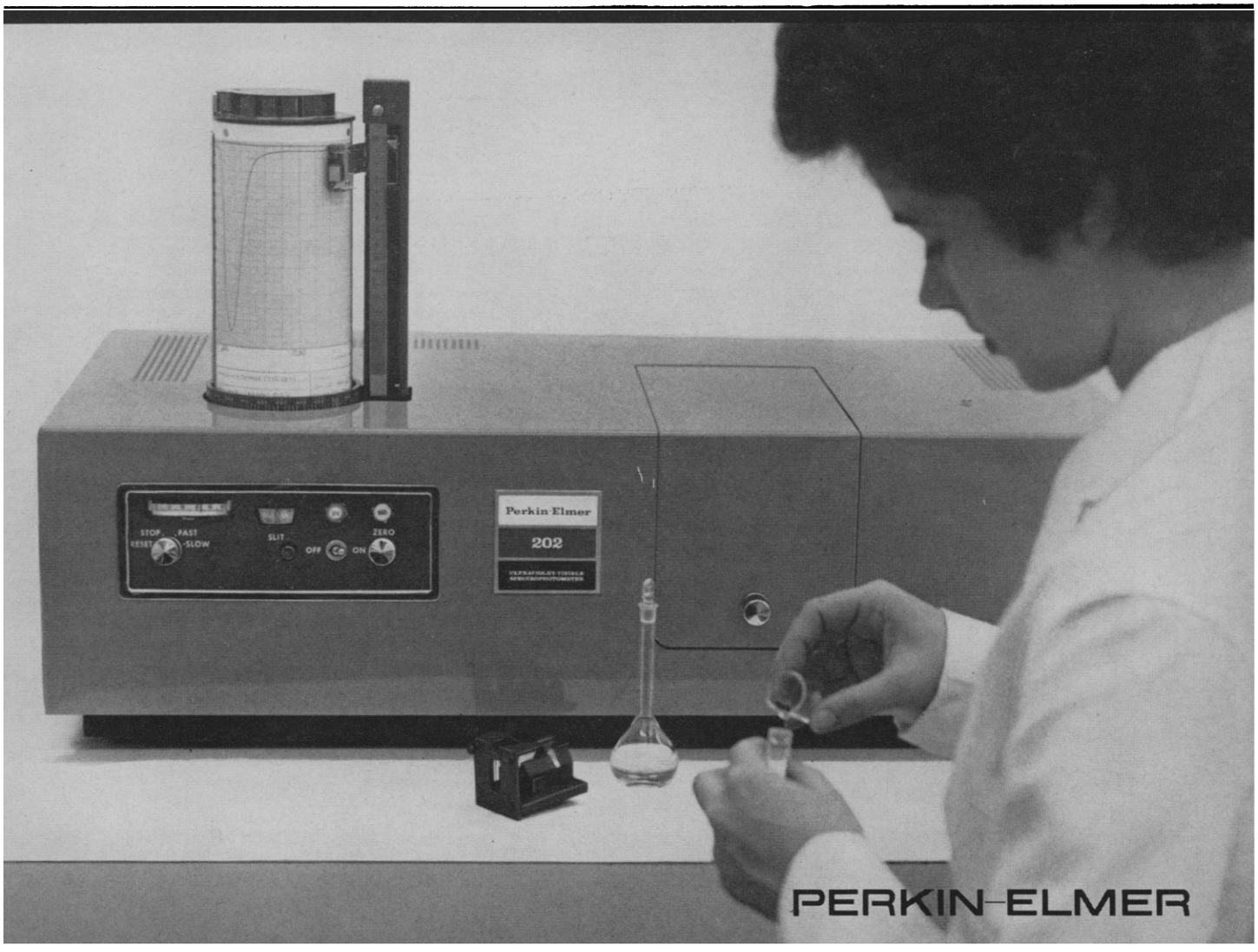
performance-proved instruments for SPECTROSCOPY

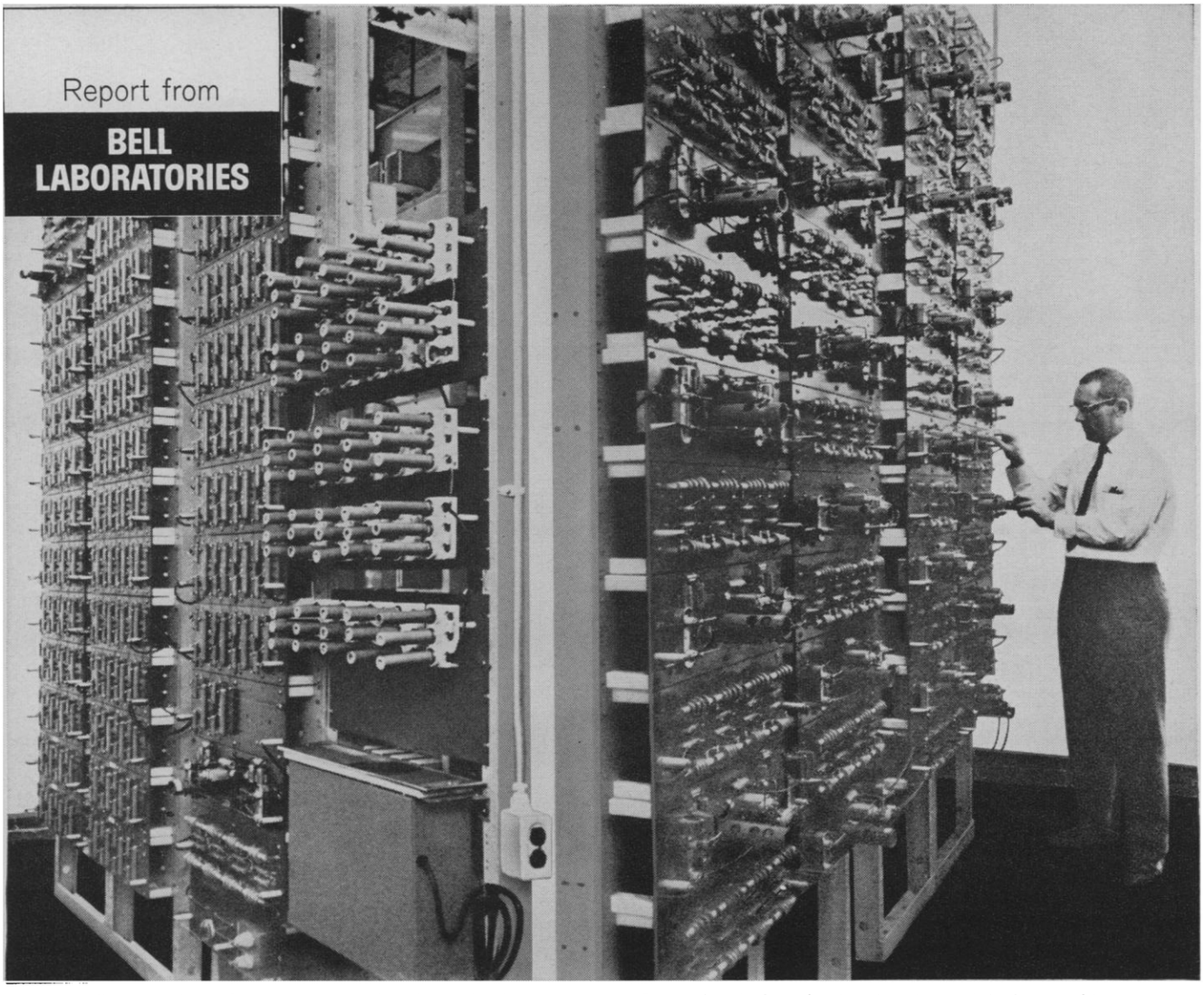
GET BIG-INSTRUMENT PERFORMANCE FROM A COMPACT, LOW COST ULTRAVIOLET-VISIBLE SPECTROPHOTOMETER—THE P-E MODEL 202

The Model 202 Ultraviolet-Visible Spectrophotometer is a great buy 3 ways: (1) as a low-cost, basic laboratory helper, for speedy and accurate handling of routine analyses; (2) as a specialist at making difficult differential analyses—a technique of growing significance in the ultraviolet and (3) as an all-around tool, enhanced in versatility by a wide range of hard-working accessories.

Self-contained, easy-to-operate, Model 202 provides high photometric accuracy and superior resolution throughout its entire broad range—190 to 390 mμ in the ultraviolet and 350 to 750 mμ in the visible. A complete range of accessories is available. Time drive, repetitive scanning, accessory readout, and other approaches to the solution of difficult problems, are well within any laboratory budget.

For brochure presenting full details and sample spectra, write to Instrument Division, Perkin-Elmer Corporation, 910 Main Avenue, Norwalk, Connecticut.





Engineer A. H. Evans measures the effect of voltage surges on Bell Laboratories' simulated undersea telephone cable. Simulating 180 amplifiers and 181 cable sections, with a total length of 3600 miles, the arrangement includes over 1100 electrical components. Photo merges two sides of the simulated cable so that both can be viewed at once.

THE UNDERSEA "CABLE" THAT NEVER GOES TO SEA

In undersea cable systems, electric power for the amplifiers is transmitted along the cable itself. To make this possible, precisely engineered circuits and devices must be designed into the system for protecting electron tubes and other components from sudden voltage surges which may result from accidental damage to the cable.

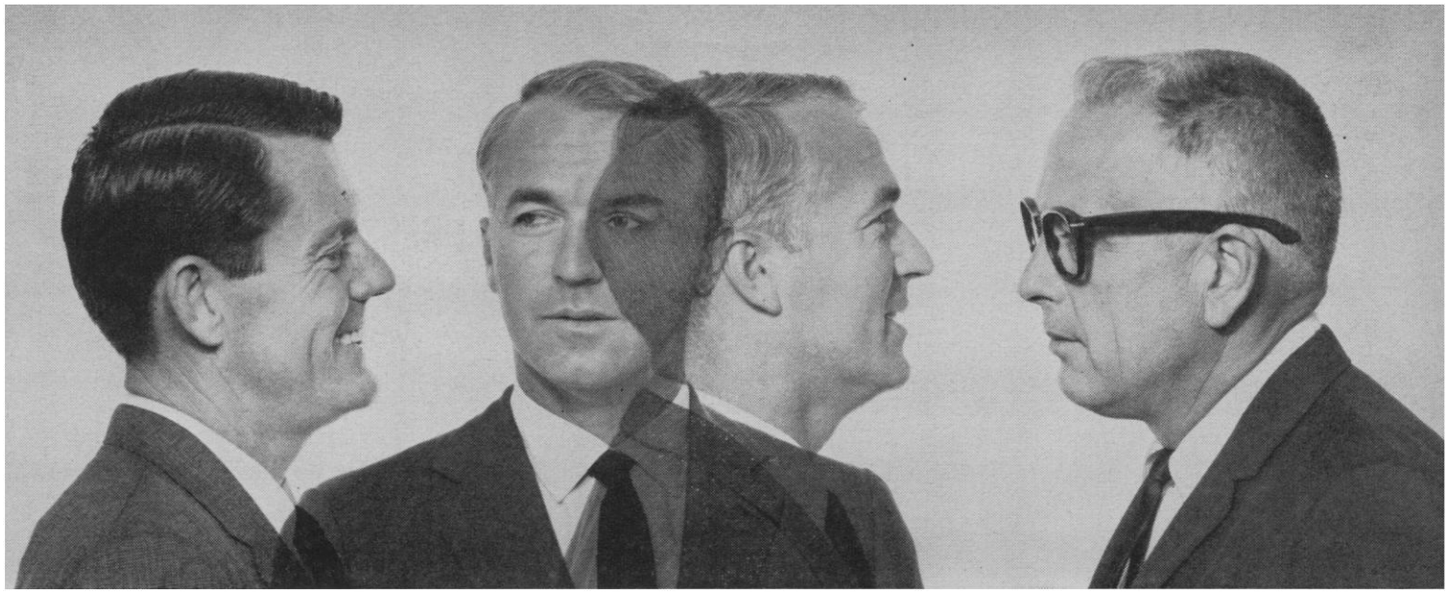
In systems such as these, the computation of the effects of such surges to establish the needed design parameters is extremely complex. Here, as in many other areas of our work, a solution to the problem has been found through electrical simulation.

Full-scale simulation is achieved by means of networks of electrical components. For the new 128-channel cable scheduled for transatlantic service this year, a network (above) was built to simulate the power path of a 3600-mile cable with its 180 amplifiers.

With the aid of this simulator, engineers can study the effects of voltage surges, the operation of electron tube protectors, and the performance of the power supply in the various contingencies that may occur in active service.

This study of unknown factors by means of electrical simulation is an example of how engineers at Bell Laboratories work to assure the performance and reliability of new communications systems before they are committed to service.

Bell Telephone Laboratories
World center of communications research and development



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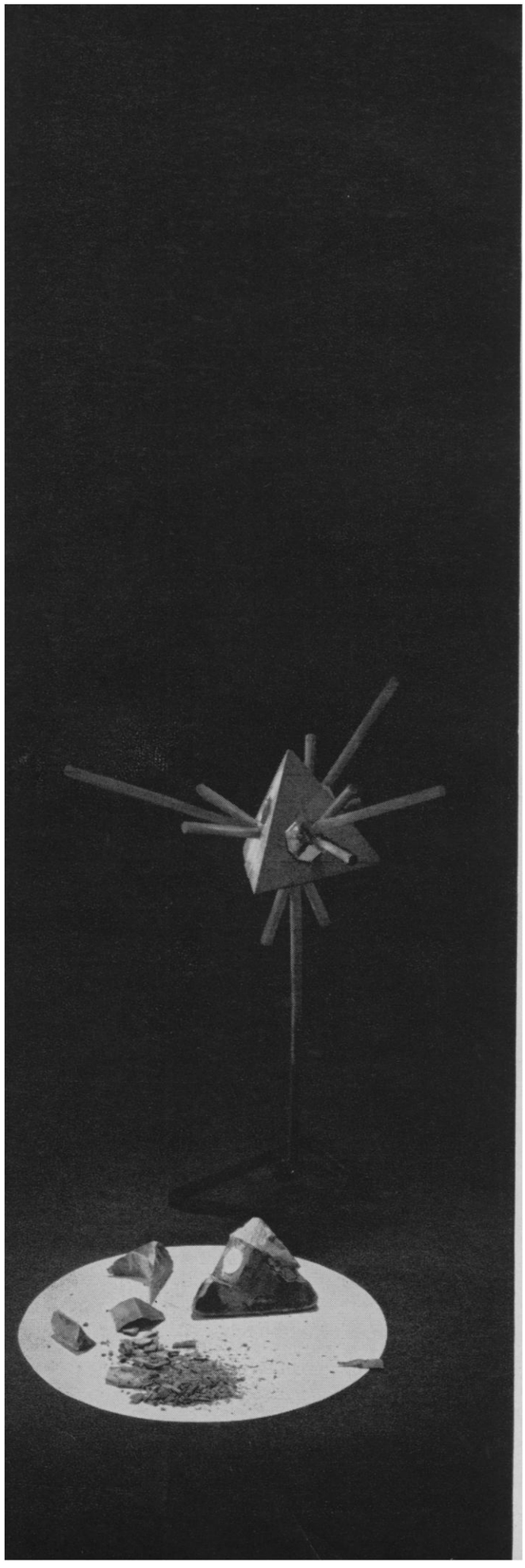


One of a series briefly describing GM's research in depth

MELTING UNDER PRESSURE (at 100,000 atmospheres)

Most substances expand as they melt. A few—such as ice and bismuth—take up less volume as they become liquids. Employing pressures up to 100,000 atmospheres, scientists at the General Motors Research Laboratories have added three tellurium compounds to a small list of remarkable materials that seem to do both—expand as they melt at low pressures, become more dense in liquid form at high pressures.

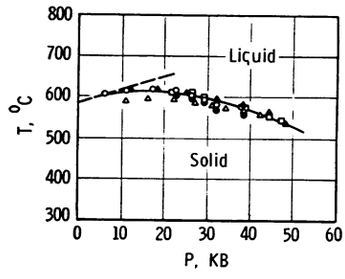
The materials in this new group exhibit a maximum melting point—a puzzling deviation from normal melting curves. They challenge the theorist to interpret such macroscopic behavior in terms of microscopic structural changes. Perhaps one clue is the decrease in electrical resistance when they melt. But how then does the structure of the liquid differ from that of the solid? And do new solid structures produced at high pressures have unusual or useful properties that can be preserved at one atmosphere?

These and other intriguing aspects of solid-liquid interactions formed the starting points for discussion at a recent international symposium on the structure, properties, and theories of liquids. Sponsored by the Research Laboratories, this seventh in a series of annual world gatherings is another way General Motors is furthering the understanding of important, unresolved areas of science.

General Motors Research Laboratories

Warren, Michigan

Tetrahedrons are sample holders used in the Laboratories' 600-ton tetrahedral anvil apparatus. Force on four sides is transmitted to cylindrical specimen inside.



Melting point curve for Bi_2Te_3

Displays

Through a Glass, Clearly

Looking at a display is rather like holding up a magnifying glass to one small bit of information from among a vast tonnage of data. When the computer has isolated the data essential to the moment, the display must then bring it up to the human eye with utmost clarity of meaning. And as a mass of programmed information increases, more and more flexibility will be demanded of both the systems and the display. Thus many important "software" questions about displayed information must be asked and answered. Where, for example, is that fine line between too little information and too much? How can rapidly changing data best be exhibited so that eye and brain quickly get the messages? When should facts and figures be shown in an ordinary manner, when in more dramatic fashion? How can displays anticipate the answering of unanticipated questions? Much of the work of SDC scientists and engineers is and has been linked together by the common denominator of displays, which in turn are the vital interaction link between machine and man... between computer and decision maker. The broad experience base being built by SDC men and women is, in turn, helping to shape the information systems of the future. If you are interested in shaping your own future in the science of systems, SDC offers opportunities of unusual scope and challenge. Human factors scientists, operations research scientists, systems-oriented engineers, and computer programmers are invited to write Mr. A. K. Granville, Jr., SDC, 2407 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C.; Lexington, Massachusetts; Paramus, New Jersey; and Dayton, Ohio. "An equal opportunity employer."

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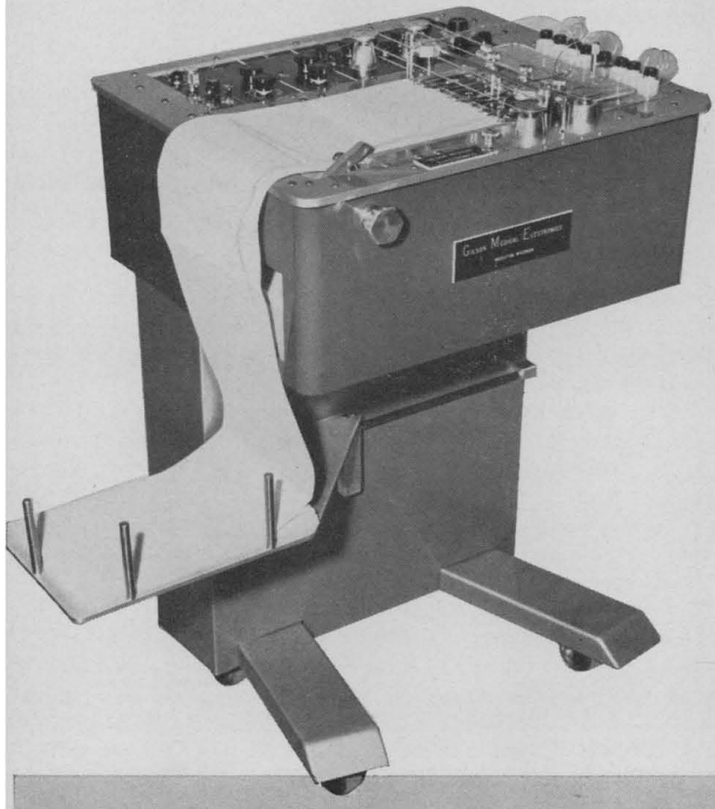
MODEL M5P MINI-POLYGRAPH



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MODEL M8PM FULLY MODULAR 8-CHANNEL MACRO-POLYGRAPH AVAILABLE

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Separating the R from the D

National expenditures for Research and Development—now some $16 billion a year—and confusion between the R and the D parts of this total have come to the point of threatening both parts. Many a congressman or taxpayer considers $16 billion far too much to spend on the biology of the bumblebee, or whatever else he chooses as his favorite target, without realizing that the total also buys a great deal that he insists on having. The label *science* has been stretched so far that engineers frequently chafe at the lack of distinction between science and engineering. And when a leading newspaper equates science with a depilatory in the headline "Science supplants preoperative shaving," the public can be expected to rebel at the idea of paying $16 billion a year for "science."

The confusion has developed partly because *research* and *science* seemed commercially useful and impressive terms, and partly because it once seemed good strategy to blur the distinctions between basic and applied research or between science and engineering. An agency that wanted funds for basic research thought that justification in terms of military, health, or other practical and easily understood objectives enhanced its chances of getting those funds.

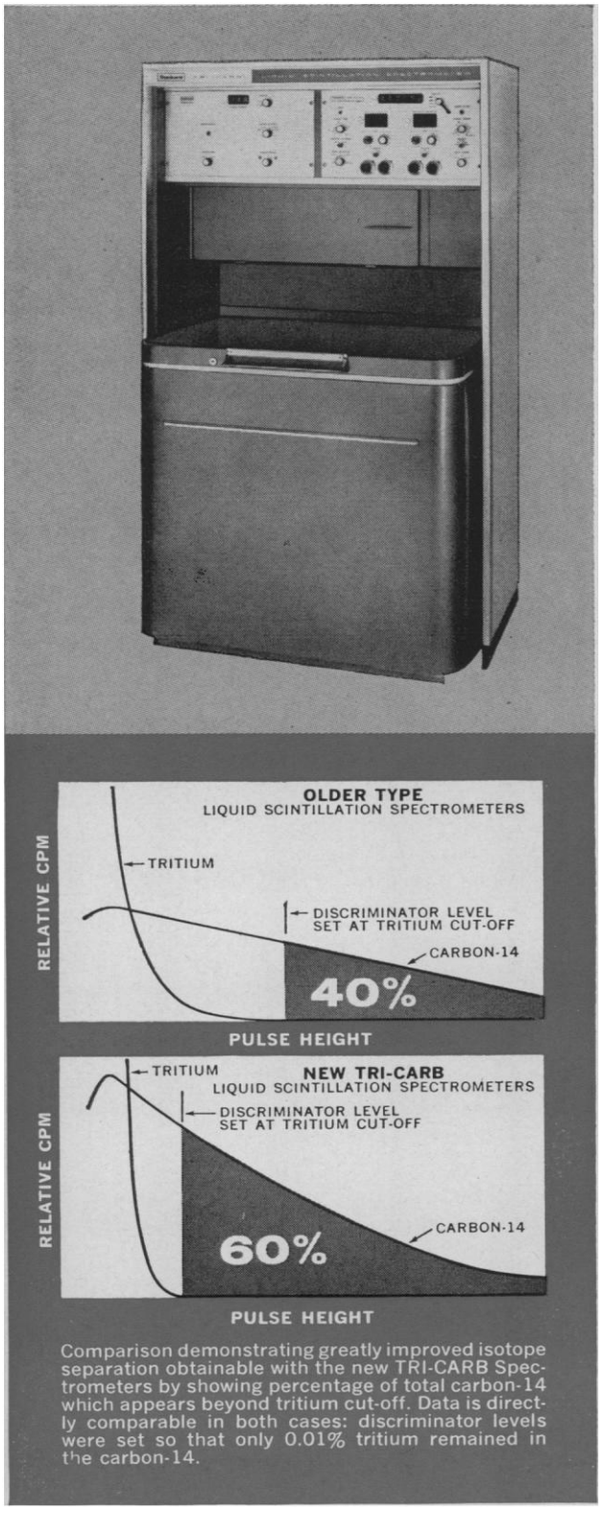
But confusion and misunderstanding have now gotten to a stage at which it seems necessary to separate the R and the D parts of the R & D budget. Admittedly it is impossible to draw a neat line that unequivocally distinguishes basic from applied research, or applied research from development; the definitions all get fuzzy at the edges. But useful distinctions can be made, and are. For example, the National Science Foundation annually publishes financial data on basic research and on the whole R & D budget.

It would be a contribution to clarity of thinking and would help government officials and taxpayers to understand better what the nation is buying if budgets, financial reports, and articles analyzing trends were to treat basic research and all of the rest of the R & D total as two separate categories. The large category (now about 90 percent of the total) could be debated and decided upon in terms of military necessities, health improvements, space aspirations, and other national goals. The smaller category (now about 10 percent) would be debated and decided upon in terms of its contribution to increasing human knowledge, the values of basic research as an intellectual pursuit, and the expectation that a reasonable portion of the findings would lead to useful applications.

A recent NSF report on national trends in R & D funds (*Reviews of Data on Research and Development*, Number 41, September 1963) provides useful figures on the amounts devoted to basic research since 1953–54. Annual expenditures from all sources increased 244 percent between 1953–54 and 1961–62. Growth of the federal government's contribution has been the most rapid, 335 percent, but not grossly out of line with increases in the amounts from other contributors: 139 percent from industry, 190 percent from colleges and universities, and 286 percent from other nonprofit institutions. The total from all four sources increased from $432 million, or 0.11 percent of the gross national product, in 1953–54, to $1488 million, or 0.28 percent of the gross national product, in 1961–62.

These figures appear reasonable in view of the nation's wealth and its desire to achieve the values that come from basic research. The time has come to discuss and defend basic research and development separately, each in terms of its own costs and its own values.—D.W.

Better Isotope Separation IN NEW TRI-CARB® SPECTROMETERS



Comparison demonstrating greatly improved isotope separation obtainable with the new TRI-CARB Spectrometers by showing percentage of total carbon-14 which appears beyond tritium cut-off. Data is directly comparable in both cases: discriminator levels were set so that only 0.01% tritium remained in the carbon-14.

The capability of a liquid scintillation spectrometer to separate isotopes in a double-labeled sample can be measured by its ability to screen the weaker isotope out of the spectrum of the more energetic one while maintaining optimum counting efficiency for each. At the same time, the instrument must be capable of accepting and amplifying linearly pulses of different magnitudes to permit simultaneous counting of isotopes with widely varying energies. New Tri-Carb Liquid Scintillation Spectrometers provide unequalled isotope separation in a broad range of counting situations because they incorporate:

(a) *Pulse Summation—which provides a more precise reproduction of the spectral shapes of low energy isotopes.*

(b) *Precisely adjustable channels of pulse-height analysis with separate, non-overloading amplifiers for each channel.*

PULSE SUMMATION

Pulse Summation is an exclusive Packard development for utilizing essentially all of the light energy produced in liquid scintillation solutions, instead of only half of the light as in older coincidence-type liquid scintillation spectrometers. In the liquid scintillation process, the total number of photons emitted for each low energy beta particle is very small. Even with the best light collection and photocathode conversion efficiencies, only one or two photoelectrons are produced in each photomultiplier tube from an average 6 kev tritium particle. By doubling the number of photoelectrons analyzed through the full use of *both* photomultiplier tubes for pulse summation and subsequent pulse-height analysis, a substantial advantage can be achieved in the statistics of photon collection and photoelectron utilization. **The more precise spectral curves achieved in new Tri-Carb Spectrometers as a result of better statistics, provide unequalled separation of low energy isotopes such as tritium and carbon-14.**

SEPARATE CHANNELS OF ANALYSIS

New Tri-Carb Spectrometers provide truly separate channels of pulse-height analysis with adjustable upper and lower discriminator levels on each channel. Three interacting gain controls for each channel permit precise adjustment of pulse attenuation, without distortion, even when handling isotopes with maximum energies varying as much as 100:1. Circuit design limits amplifier overload to approximately 400X; recovery time at this overload is only 0.4 μsec. **This allows highly accurate selection of optimum counting conditions for each channel of analysis, and permits routine measurement of isotope mixtures such as tritium and phosphorous-32.**

Better isotope separation is just one of many significant new features now available in Packard Tri-Carb Spectrometers. Ask your Packard Sales Engineer for complete details, or write for Bulletin.

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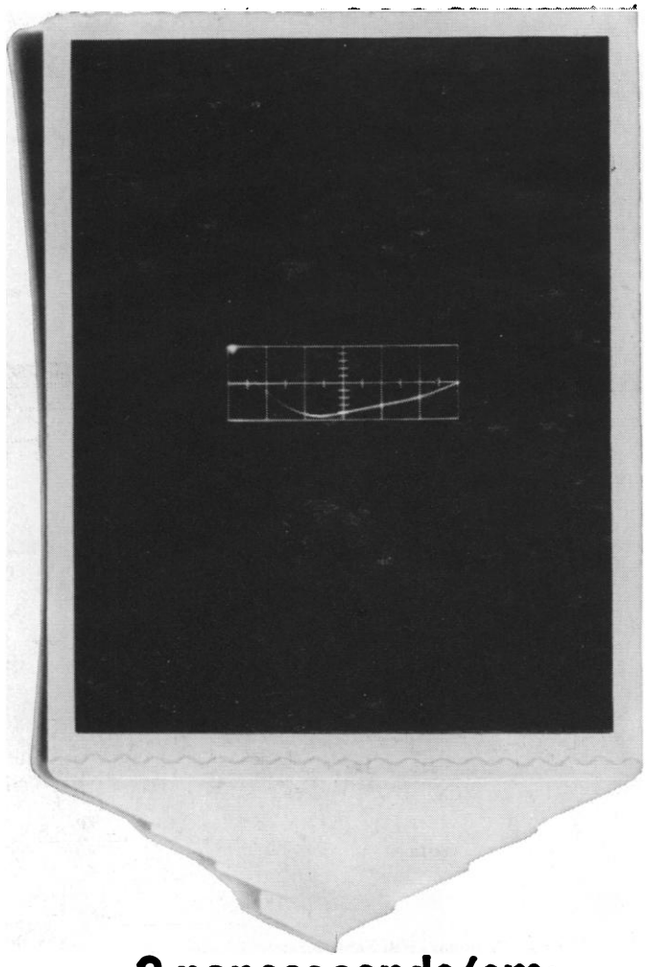


2 nanoseconds/cm: impossible to photograph until now

Polaroid has a new film that is so fast, it will reproduce scope traces that are almost invisible to the naked eye. The one above, a scintillation pulse, has never been photographed until now. Pulse duration was ten nanoseconds. Scope sweep speed was 2 nanoseconds/cm. *The new 10,000-speed Polaroid PolaScope Land film produced a finished usable print ten seconds after exposure.*

The maximum writing speed of the 10,000-speed film is about twice that of the Polaroid Land 3000-speed film, which is currently the standard for high speed photography. The new film not only gets "impossible" pictures, it also produces far better shots of slower pulses and steady state waveforms. Because of its high speed, less light is required; camera aperture and scope intensity can be reduced considerably, producing sharper pictures.

And besides oscillography, the PolaScope film opens up new possibilities in applications where light is at a premium, such as photomicrography and metallography. It is not suited, however, for pictorial work due to its high contrast and relatively coarse grain.

PolaScope film (designated Type 410) is packed twelve rolls to a carton. The price is about the same as the 3000-speed film.

The film can be obtained through industrial photographic dealers. For the name of the dealer nearest you, write to Technical Sales Department, Polaroid Corporation, Cambridge 39, Massachusetts.

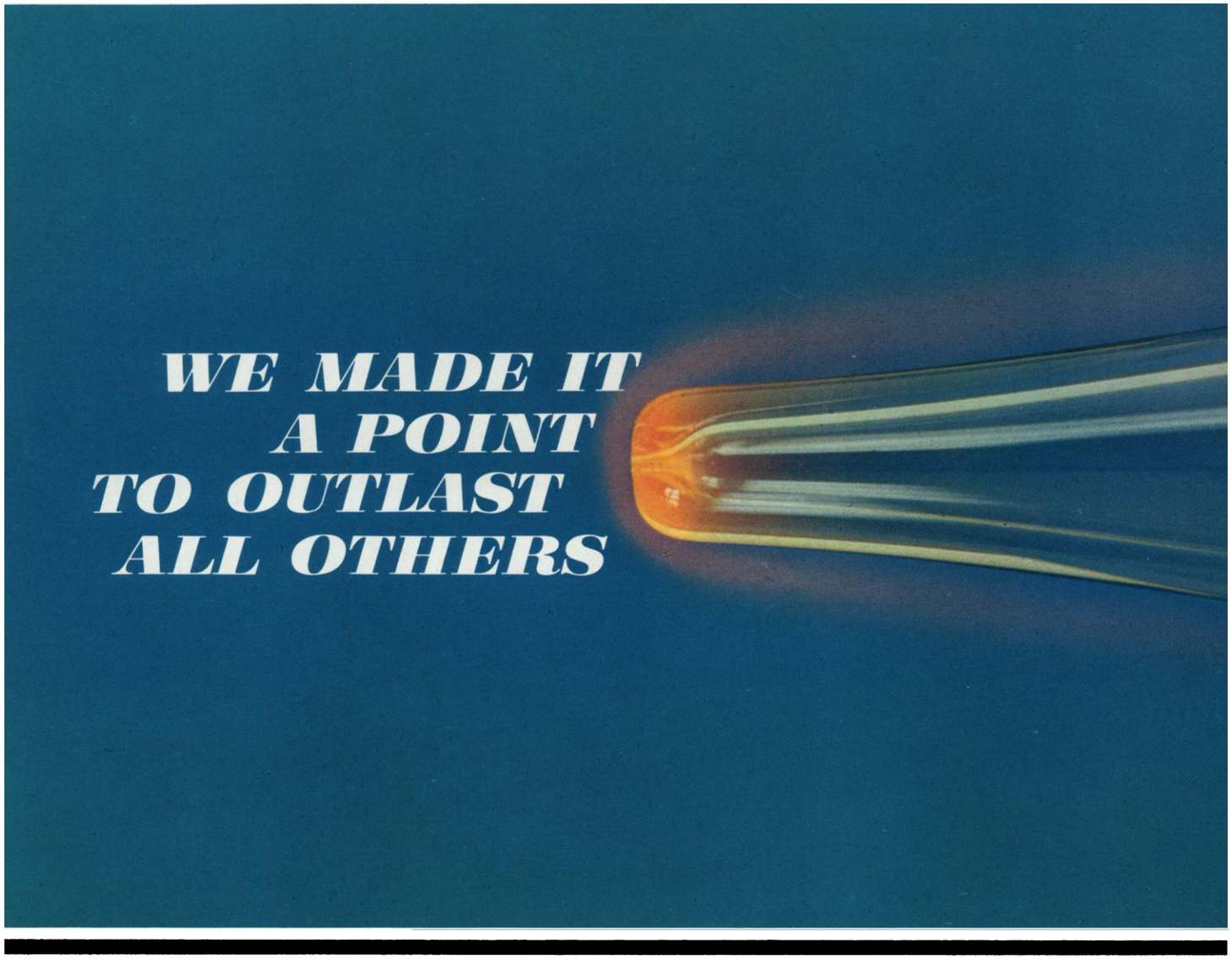
New Polaroid Land 10,000-speed film for oscillography.

KIMAX® QUALITY FROM TOP TO TIP

Fire-Finished Top
Glazed to provide a smooth round edge for safe, comfortable use, precise delivery control, and rugged inherent strength.

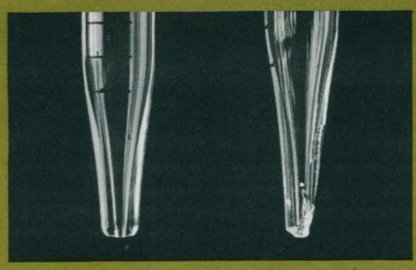
Color-Coding
Another Kimble innovation for rapid, positive identification. Color bands for size and style are fused on the surface to last the life of the pipet.

Stain-Fused Graduations
Permanent markings, without etching. Permits large bold numbers . . . no weakened surface or impurity-harboring crevices.



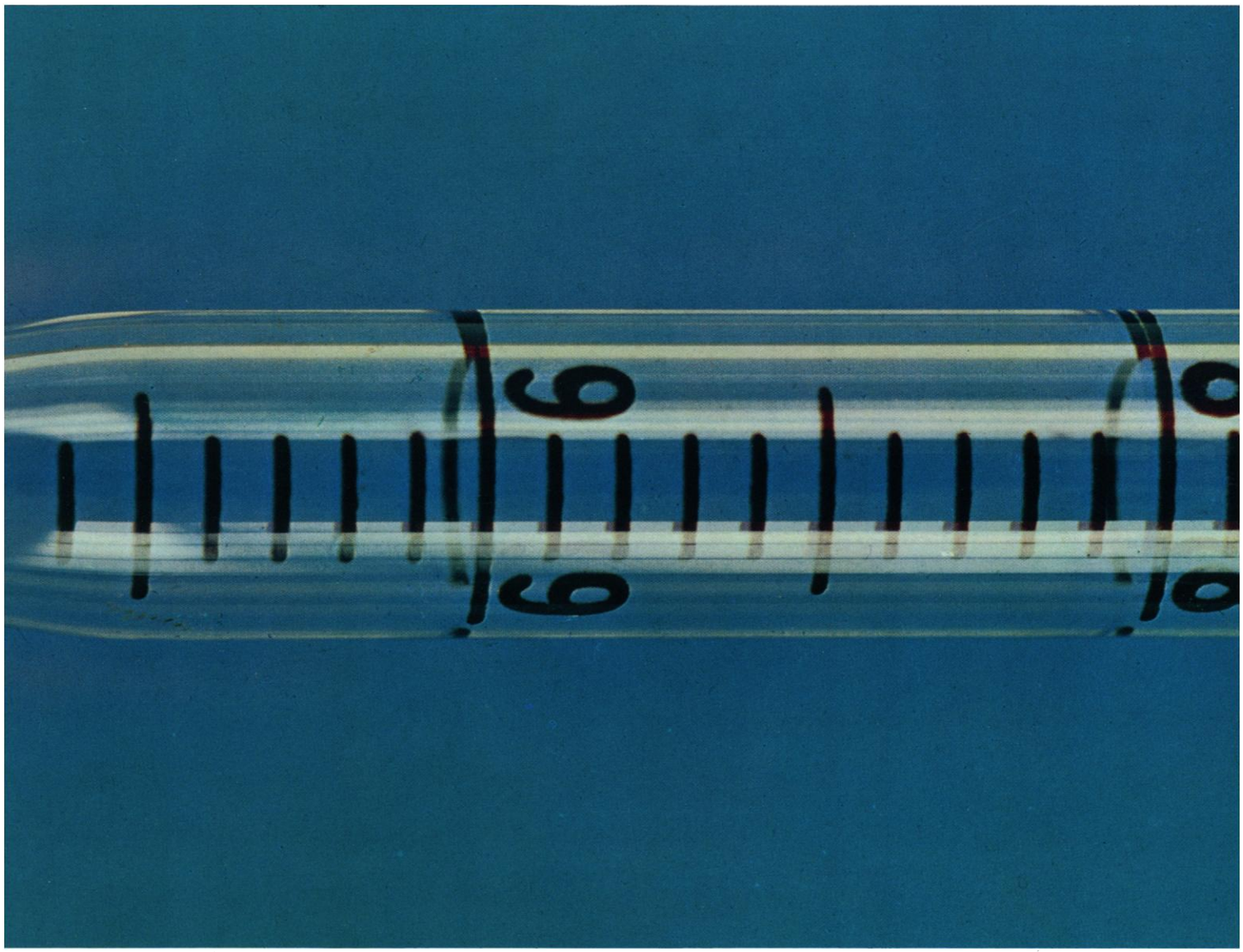
New SAFE-GARD® pipet with tempered tip for high impact strength

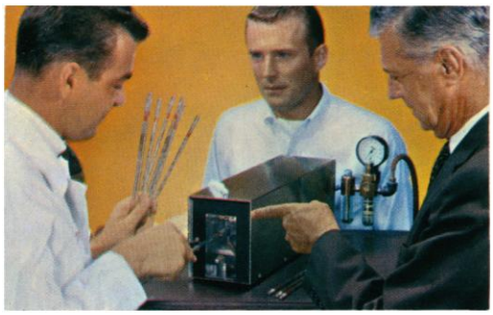
The problem: Many times, average pipets have to be discarded long before they shatter completely, because of chipped tips and marred and scarred surfaces. ■ The solution: A new Kimble serological pipet with a flame-polished *tempered tip.* This tempered tip stubbornly resists chipping and cracking while the rest of the pipet withstands the repeated abuse of washing, sterilizing, sorting and just plain using. This is the new SAFE-GARD pipet . . . *and it costs you no more.* ■ A special borosilicate glass—Kimax-51—provides SAFE-GARD pipets with their exceptional chemical durability and surface hardness. Their lab life has been substantially increased because of their resistance to clouding, to surface scratches and abrasion. ■ Additional strength characteristics in scientific products usually command premium prices. Kimble put designing improvements exactly where lab use dictates. You get this premium pipet at the same low price you pay for regular pipets.



DROP TESTS PROVE IT!

Time after time, in carefully controlled ascending drop test averages, the armored tip of this new SAFE-GARD pipet (shown at far left) outperformed pipets with regular ground tips ...survived falls from 80% to 200% higher onto a hard surface.





NEW AUTOMATIC PLUGGING MACHINE OFFERS SPEED, PRECISION

New from Kimble, this compact machine swiftly feeds, holds, cuts, and rams the cotton automatically. As fast as an operator can apply a pipet to the plugger, a precisely measured plug is mechanically inserted . . . at the rate of 40 or more per minute. Assures a ready supply of plugged pipets at all times. Eliminates the waste of costly technician's time.

OWENS-ILLINOIS

maker of Kimble Products
Toledo 1, Ohio

Kodak advertises:

Diketene, that terrible stuff... the work of moonlighting astronomers... a product for draftsmen and possibly others

A new chemical Chicago

Diketene (CH_2COCH_2CO) is terrible stuff. It brings tears to the eyes even in small whiffs, smells awful, once killed a shaved guinea pig bathed with it, and may polymerize violently when catalyzed by casual contamination. For carelessness with it, one ought to go to jail.

To keep it out of inexpert hands and for other more or less obvious reasons, we sell no less than 39,000 pounds at a crack and are proud of our achievement in bringing it to market. It comes in its own stainless steel tank truck, insulated heavily enough to stay safely near the −7.5°C freezing point for up to 72 hours. Obviously anybody willing to have this truck pull up to the gate with the driver complaining of unseasonable heat on the road the past 2½ days and asking where to connect up to the refrigerated storage tanks will have given the matter considerable thought in advance. Very likely, despite the touchy nature of *Diketene* and because it works directly without troublesome by-products, he will have chosen it as a replacement for methyl or ethyl acetoacetate.

To explain to a liberal-arts wife the now threatened role of these acetoacetates in civilization offers difficulty. To point out that in $CH_3COCH_2COOC_2H_5$ the methylene group with an acetyl group on one side and a carbethoxy group on the other is highly activated for conversion to mono- and dialkyl C-substitution products and that these and the parent compounds with their two different carbonyl-containing groups joined to the methylene group can undergo hydrolytic cleavage—all this begs the question and plants in her mind a little seed of doubt as to whether you are really as dependable as everybody says you are. Instead, you might sum up that ethyl acetoacetate has been a sort of chemical Chicago, from which one can go in any of many directions. For historical perspective, you might point out that ethyl acetoacetate has had to be made by an expensive sodium-ethyl acetate route, now to be by-passed as rising standards of safety and materials-handling sophistication make *Diketene* a practical commodity of commerce.

On the other hand, that's a lot of pointing out and summing up to do. Perhaps it is enough to say that *Diketene* is used to make drugs, dyes, and agricultural chemicals (which is probably true, even if you have nothing specific in mind). When she asks whether they really need all those agricultural chemicals, gently turn her attention to the problem of what to get the kids for Christmas.

We have spent as much as $500 moving a 2-gallon free sample of Diketene *1500 miles from Eastman Chemical Products, Inc., Kingsport, Tenn. (Subsidiary of Eastman Kodak Company) and can't afford too much of* that, *but this is the place with which to establish mutual earnestness of purpose.*

Radiometry of the epidermis

Policemen often moonlight. Many male schoolteachers moonlight. Work by the light of the moon to supplement one's income can be honorable, stimulating, and even necessary. When an astronomer (whose professional concerns encompass moonlight) wants to moonlight, he acquires some KODAK IRTRAN 4 Optical Material from Apparatus and Optical Division, Eastman Kodak Company, Rochester 4, N. Y. and fabricates it into a small converging lens. This transmits infrared from 1 to 20μ, a band wherein falls nearly all the energy emitted by sources around 300°K. Knowing that the human epidermis is normally a 310°K emitter, he builds the lens into a portable instrument for measuring temperature variation over small epidermal areas without actual contact and the error so introduced. He arranges for the lens to image a small area on a thermistor in a bridge circuit with microammeter. The lens makes the response independent of exact distance.

After permitting use of this instrument in clinical practice for several months, the moonlighting astronomer sounds like this:

A female who had Raynaud's disease was scanned 5 days after 2 fingers had been amputated to the first joint. At the site of amputation the indicated temperature was lower than 2 cm back from the end of the wound. The surgeon wouldn't use a skin thermometer for fear of causing an infection in the open wound.

A female presented herself with a small mass at the outer quadrant of the right breast; palpable with difficulty. It showed a 0.7°F rise in the area. She was hospitalized and a biopsy performed. An adenocarcinoma was found and removed.

An elderly male with a deformed, ulcerated lesion of the right ear cartilage was examined. An 0.5°F increase over the involved area was noted. It was resected and a basal cell carcinoma was found.

A female came in with psoriasis which gave rises of about 1°F over the involved areas. It was inflamed. It is notable that temperature elevations are not obtained over static cases of psoriasis.

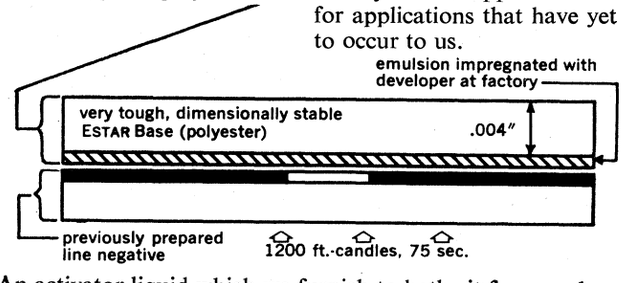
A 17-year-old female with a soft mass in the left breast presented herself. The reading was 0.5°F cooler than the surrounding tissue. One week later surgery showed that it was benign.

A male was burned on the right leg. The leg was bandaged. On the third day an elevation in body temperature was noted, suggesting an infection. On scanning the bandage a reading at the knee showed a 2°F rise. On removal of the bandage the infection site was verified.

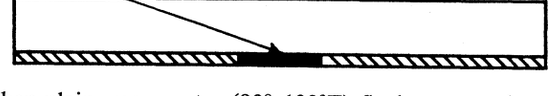
The only way currently to learn anything further about this line of development is to inquire of The Dudley Observatory (Chartered 1852), 140 South Lake Avenue, Albany, N. Y.

Wash away all but the image
(and erase as much of *that* as you like)

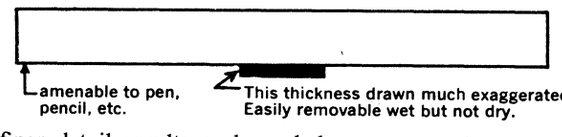
For certain drafting-room procedures that may fail to interest the general reader, we now place upon the market a silver-sensitized photographic film that may indeed appeal to him for applications that have yet to occur to us.



An activator liquid which we furnish to bathe it for anywhere from ½ to 2 minutes at 65°-85°F turns the exposed areas very black



and then plain warm water (80°-100°F) flushes away the unblackened emulsion in a minute or so.



Far finer detail results and much less exposure is required than with bichromated gelatin. Bichromated gelatin is very ancient. Time to forget it, perhaps? If you ever remembered.

For the name of a dealer who quotes sizes and prices on this KODAK Wash-Off Drafting Film, *write Eastman Kodak Company, Photo Reproduction Division, Rochester 4, N. Y.*

FORTHCOMING EVENTS

Winter Gordon Research Conferences

The Winter Gordon Research Conferences will be held from 27 January to 7 February 1964 at the Miramar Hotel, Santa Barbara, California. The purpose of the Gordon Research Conferences, which is to stimulate research in universities, research foundations, and industrial laboratories, is achieved by an informal type of meeting consisting of scheduled lectures and discussion groups. Sufficient time is available to stimulate informal discussions among the members of each conference. Meetings are held in the morning and in the evening, Monday through Friday, with the exception of Friday evening. The afternooons are available for recreation, reading, or participation in discussion groups as the individual desires. This type of meeting is a valuable means of disseminating information and ideas to an extent that could not be achieved through the usual channels of publication and presentation at scientific meetings. It is hoped that each conference will extend the frontiers of science by fostering a free and informal exchange of ideas among persons actively interested in the subjects under discussion. The summer conferences are held in New Hampshire [Science **139**, 1006 (1963)].

Registration and Reservations. Attendance at the conferences, limited to approximately 100, is by application. Individuals interested in attending the conferences are requested to send their applications to the office of the director. Applications must be submitted in duplicate on the standard form, which may be obtained from the office of the director. The applications will be reviewed by the Conference Committee. This committee, in selecting the participants, will distribute the attendance as widely as possible among the institutions and laboratories represented by the applications. A registration card will be mailed to those selected. Advance registration by mail is required; this is completed when the registration card, with a deposit of $15, is received in the office of the director. A registration card not accompanied by the deposit will not be accepted; this advance deposit is not required of scientists from foreign countries.

A fixed fee of $115 has been established for resident conferees, covering registration, room (except single room),

meals, and gratuities, for 5 days. This fee was established to encourage attendance for the entire conference and to increase the special fund that is available to the conference chairmen for assisting participants who attend the conference wholly or in part at their own expense.

The participants are expected to live at the conference location because one of the objectives of the conference is to provide a place where scientists can get together informally to discuss scientific research. All participants are urged to attend the conference for the entire week. Under special circumstances conferees will be permitted to stay at locations other than the site of the conference. Such nonresident conferees will be charged a registration fee of $50.

Conferees living at the conference location who will pay all or part of the fixed fee as a personal expense may request a reduction of $25 in the fixed fee. Application for this special fee must be made at the conference office during the conference.

Accommodations are available for wives who wish to accompany their husbands, and for children 12 years of age and over. All such requests should be made at the time the attendance application is submitted. The charge for room and meals for a guest is $75, including gratuities, for 5 days.

Cancellation. The $15 deposit is forfeited if an approved application for attendance at a conference is cancelled.

Attendance. Requests for attendance at the conferences or for additional information should be addressed to W. George Parks, Director, Gordon Research Conferences, University of Rhode Island, Kingston, Rhode Island.

The following is an outline of the program.

Polymers

Maurice L. Huggins and Bruno H. Zimm will serve as *chairman* and *vice chairman*, respectively, during these sessions.

27 Jan. H. Mark, "Recent progress in polymer research"; W. Kern, "Organochemical and analytical studies of polymers."

28 Jan. I. Nitta, "The structure of crystalline polymers"; F. E. Bailey, "Association complexes of polymers."

29 Jan. T. W. Campbell, "High temperature polymers"; C. S. Marvel and J. E. Mulvaney, "Polyaromatics"; F. R. Mayo, "The role of oxygen in the formation and degradation of polymers"; J. F. Johnson, "Degradation

studies of polymers with defined distribution."

30 Jan. A. J. Havlik and R. Simha, "Equation of state of polymer liquids; glass transitions"; A. A. Berlin, (subject to be announced); G. Natta, G. Mazzanti and G. Dall'Asta, "Polymerization of cyclic olefins."

31 Jan. K. Fukui, "Toward a theoretical strategy for the chemistry of polymerization"; S. E. Bresler, (subject to be announced); J. F. Smith, "Application of computer techniques to the prediction of copolymer compositions."

Electrochemistry: Electrode Reactions

Ralph N. Adams and Richard Buck are *chairman* and *vice chairman*, respectively.

3–7 Feb. Paul Delahay, "Double layer and electrode kinetics"; Lucien Gierst, "Cation effects on electrode kinetics"; A. C. Riddiford, "Rotated disk electrodes"; Philip J. Boddy, "Anion effects on potential distribution at a germanium electrode"; Donald Smith, "Electrochemical studies of rapid homogeneous chemical reactions employing AC techniques"; Allen J. Bard, "Coulometry applied to electrode mechanism studies"; Henry Taube, "Electron exchange reactions"; G. C. Barker, "Photo currents at mercury electrodes"; Manfred Breiter, "Kinetics of hydrogen and deuterium discharge on platinum"; Leon Dorfman, "Pulse radiolysis studies of the electron in polar liquids"; N. Sutin, "Electron exchange reactions"; H. Gerischer, "Semiconductor electrodes"; E. Yeager, "Kinetics of the oxygen electrode at various surfaces"; W. H. Reinmuth, "Impluse relaxation techniques"; Robert Osteryoung, "Adsorption studies at solid electrodes"; S. Bruckenstein, "Ring-disk electrode techniques."

W. George Parks
University of Rhode Island, Kingston

Other Meetings

November

24–27. American Acad. for **Cerebral Palsy**, Dallas, Tex. (J. D. Russ, 1520 Louisiana Ave., New Orleans, La.)

25–27. **Geological** Soc. of America, 76th meeting, New York, N.Y. (F. Betz, Jr., 419 W. 117 St., New York 27)

29–30. American **Mathematical** Soc., Cleveland, Ohio. (AMS, 190 Hope St., Providence 6, R.I.)

31–1. American College of **Chest Physicians**, Portland, Ore. (M. Kornfeld, 112 E. Chestnut, Chicago 11, Ill.)