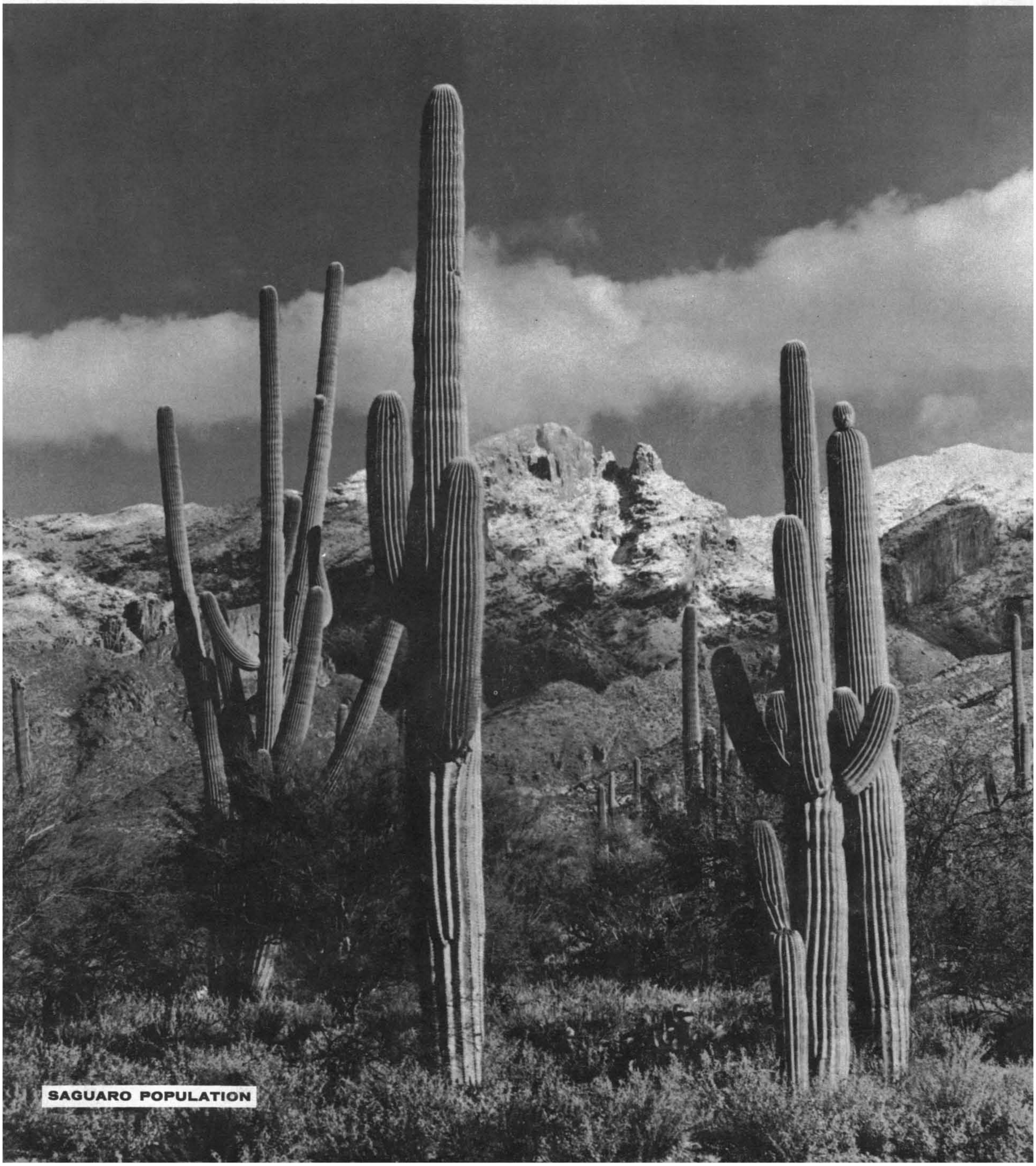
# SCIENCE

4 October 1963

Vol. 142, No. 3588

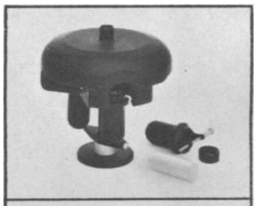
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



SAGUARO POPULATION

Here is an advanced instrument for preparative centrifugation. More sophisticated than our Model L, the new L-2 has a substantially larger rotor chamber which holds not only every Model L rotor, but bigger swinging-bucket and fixed-angle rotors with far larger sample volumes. It has a convenient system to control rotor temperature, and it has a stabilizer to prevent rotor wobble during deceleration, helping to keep fractions from remixing.

If your research calls for an advanced preparative instrument, we'd like to send you more information on our new Model L-2. Ask for Data File L2-5.



***The new Type SW 25.2 Rotor***

Holds nearly twice as much sample (180 ml) as the next biggest swinging-bucket rotor, yet generates even more force (106,900 g)!

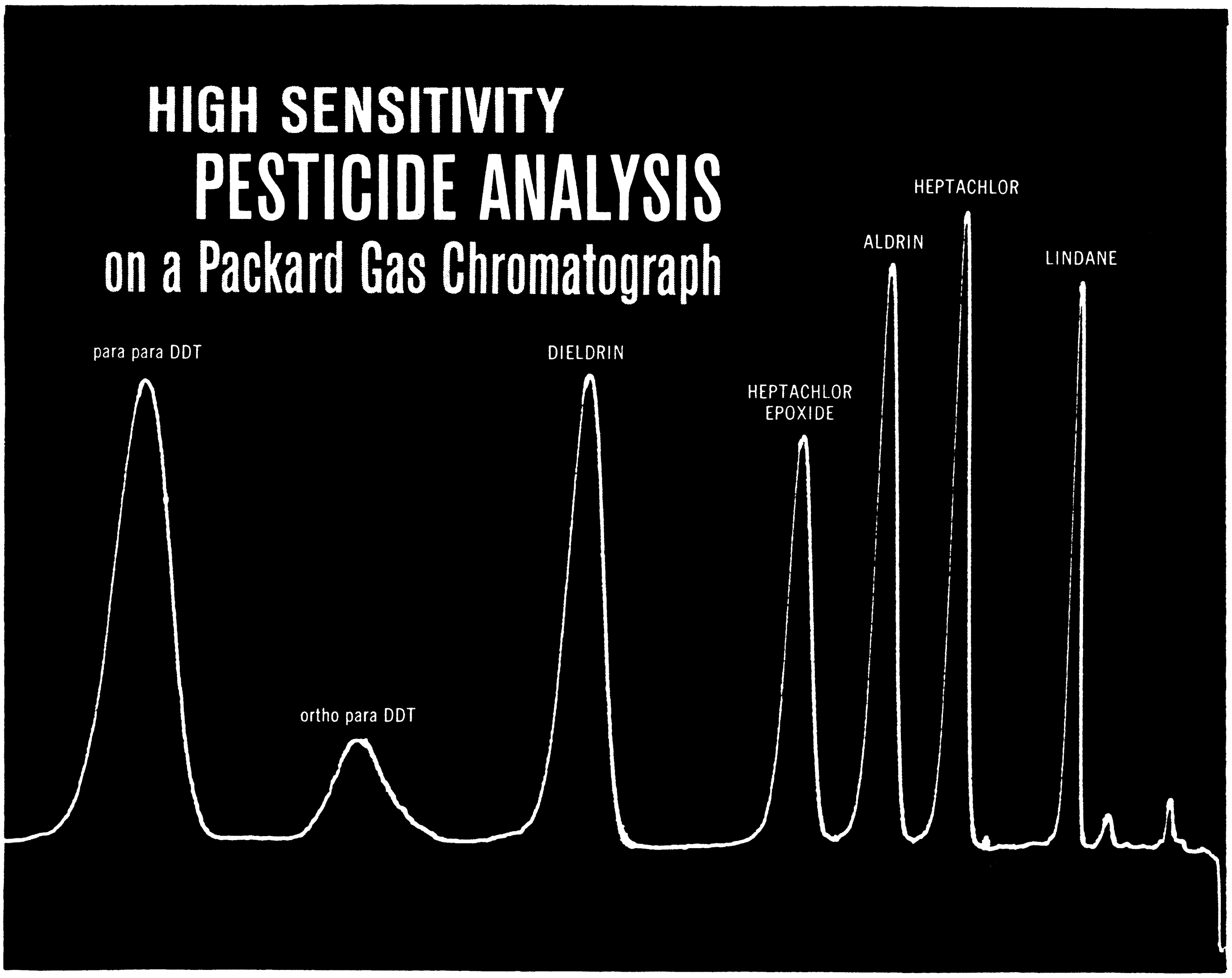
***The new Type 19 Rotor***

Spins 1.5 liters at 53,700 g! Caps for the six 250 ml bottles screw on and off easily by hand.

**Beckman®** INSTRUMENTS, INC.
**SPINCO DIVISION**
PALO ALTO, CALIFORNIA

International Subsidiaries: Geneva, Switzerland; Munich, Germany; Glenrothes, Scotland; Paris, France; Tokyo, Japan; Capetown, South Africa.

# HIGH SENSITIVITY PESTICIDE ANALYSIS on a Packard Gas Chromatograph



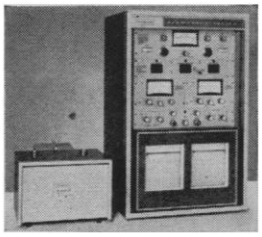
Routine determination in the parts/billion range, plus extreme versatility and speed of analysis recommend the Packard Model 7508 Gas Chromatograph to research workers in the biochemical and biomedical disciplines.

Chromatograms of pesticide analysis (above) display clearly defined peaks to indicate the instrument's high sensitivity to trace amounts. Advanced electronics embodied in the digital temperature programmer, proportional temperature control, electrometers, and high voltage supply modules extend the capability of Model 7508 to every area of gas chromatography. The Dual Column Oven which may be operated in isothermal or programmed modes, accepts any of five dual plug-in detectors. Columns and detector assemblies may be lifted out of the oven to permit changing or making connections outside heated oven area.

Your Packard Sales Engineer can provide complete details and performance criteria. Write for Bulletins and Specifications.

## EXPERIMENTAL CONDITIONS:

**SAMPLE**—2 microliters of hexane solution containing:
Lindane .25 x $10^{-9}$ gm.
Heptachlor .5 x $10^{-9}$ gm.
Aldrin .5 x $10^{-9}$ gm.
Heptachlor Epoxide .5 x $10^{-9}$ gm.
Dieldrin .75 x $10^{-9}$ gm.
ortho para DDT & para para DDT 2.5 x $10^{-9}$ gm.



**COLUMN**: 5′ x ¼″ all glass
**LIQUID PHASE**: 10% Dow Corning Silicone Fluid (DC200)
**SUBSTRATE**: 60-80 mesh Chromosorb W (acid and base washed)
**CARRIER GAS FLOW RATE**: 120 cc Nitrogen/min.
**INLET HEATER TEMP.**: 225°C
**COLUMN TEMP.**: 190°C
**DETECTOR TEMP.**: 195°C
**OUTLET TEMP.**: 200°C
**DETECTOR**: Packard Electron Capture with 150 millicurie Tritium Source
**ELECTROMETER RANGE**: 3 x $10^{-9}$ amperes full scale
**DETECTOR VOLTAGE**: 50
**NOISE LEVEL**: 3 x $10^{-12}$ amperes
**CHART SPEED**: 30 inches/hour

**Packard**

**PACKARD INSTRUMENT COMPANY, INC.**

BOX 428 • LA GRANGE, ILLINOIS • AREA CODE 312 • 485-6330

4 October 1963
Vol. 142, No. 3588

# SCIENCE

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**ARTICLES**

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**REPORTS**

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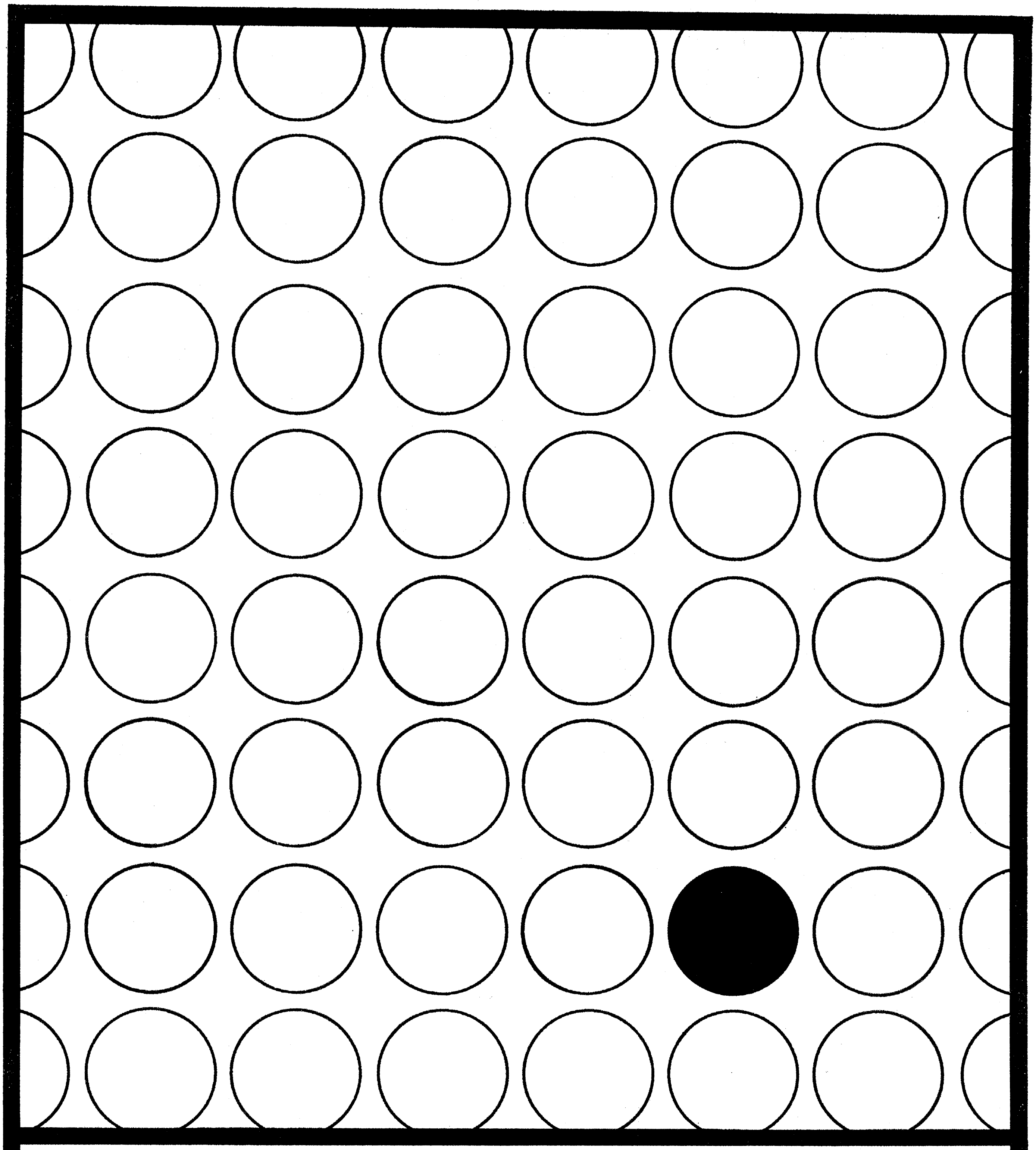
## COVER

Saguaro (*Cereus giganteus, Carnegiea gigantea*), paloverde (*Cercidium microphyllum*), and low shrub bursage (*Franseria deltoidea*) located on the stony upper bajada of the Sonoran Desert just north of Tucson, Arizona. Situated at the base of the snow-capped Santa Catalina Mountains, this saguaro population is reproducing itself in an area where vegetation has not been degraded by overgrazing. See page 15. [Walter S. Phillips]



performance-proved instruments
for SPECTROSCOPY

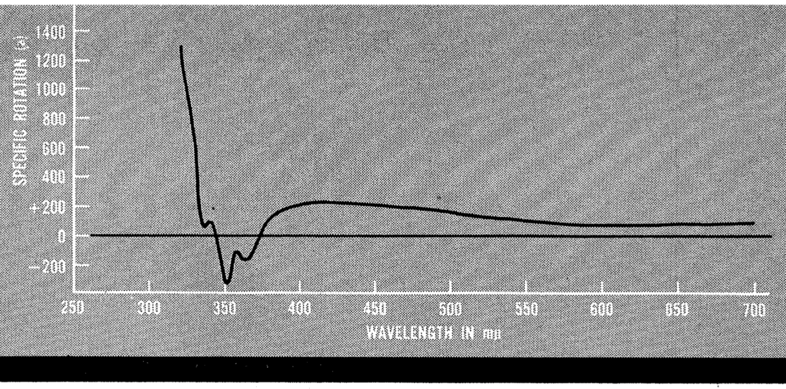


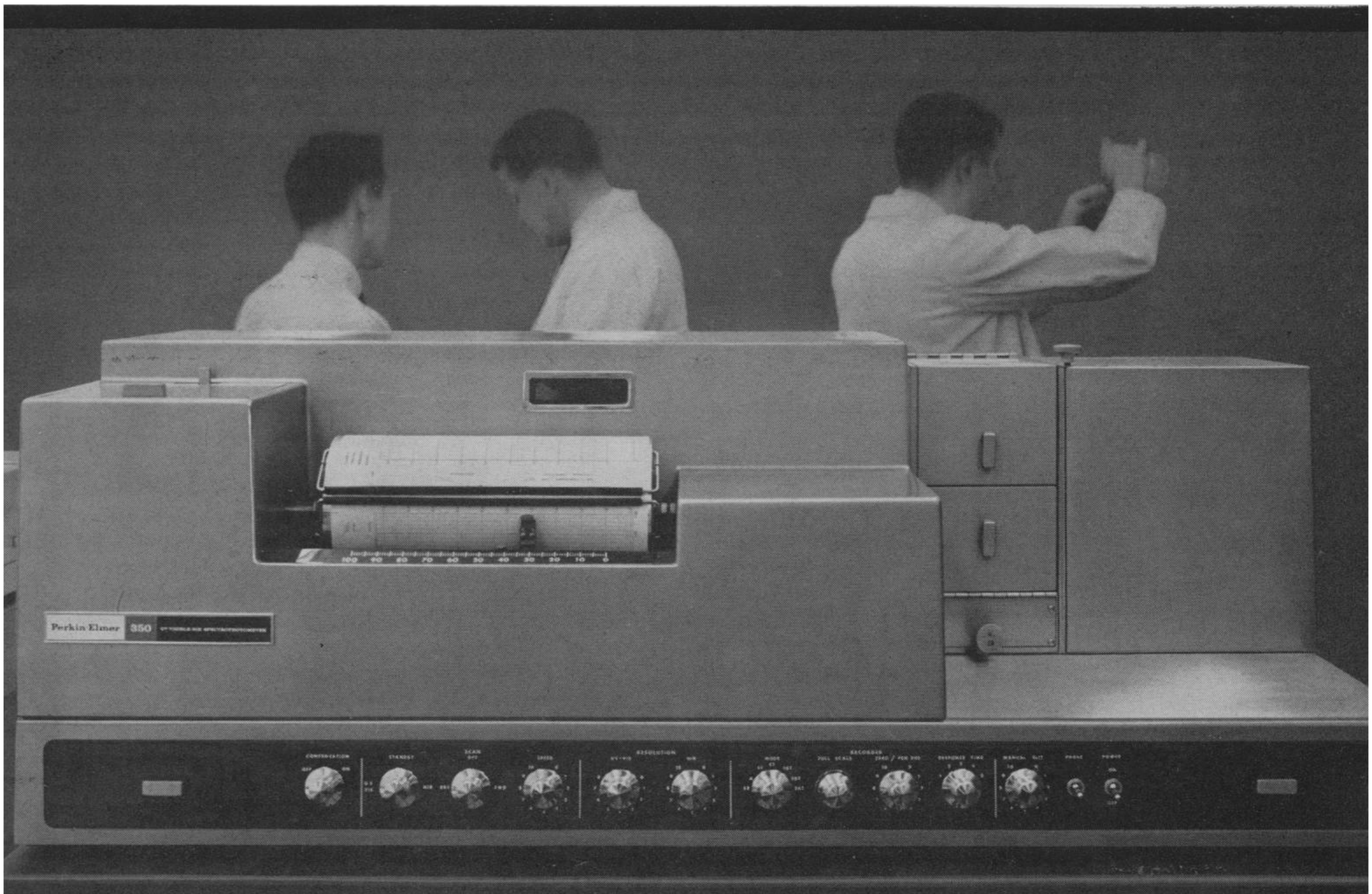
*Chart shows spectral analysis by Optical Rotatory Dispersion of 2mg of testosterone in* **p***-dioxane. With identical calcite polarizer-analyzer combinations in each beam, absorption by the sample is canceled out. Rotation of the light by the sample appears as a pen deflection on the chart, whence it is readily convertible to angular units by conversion tables provided with the accessory. The high scale expansions available on the Model 350 can be used to advantage in ORD work.*

# NO OTHER SPECTROPHOTOMETER HAS EQUAL CAPABILITIES THROUGHOUT THE FAR-ULTRAVIOLET TO NEAR INFRARED RANGE

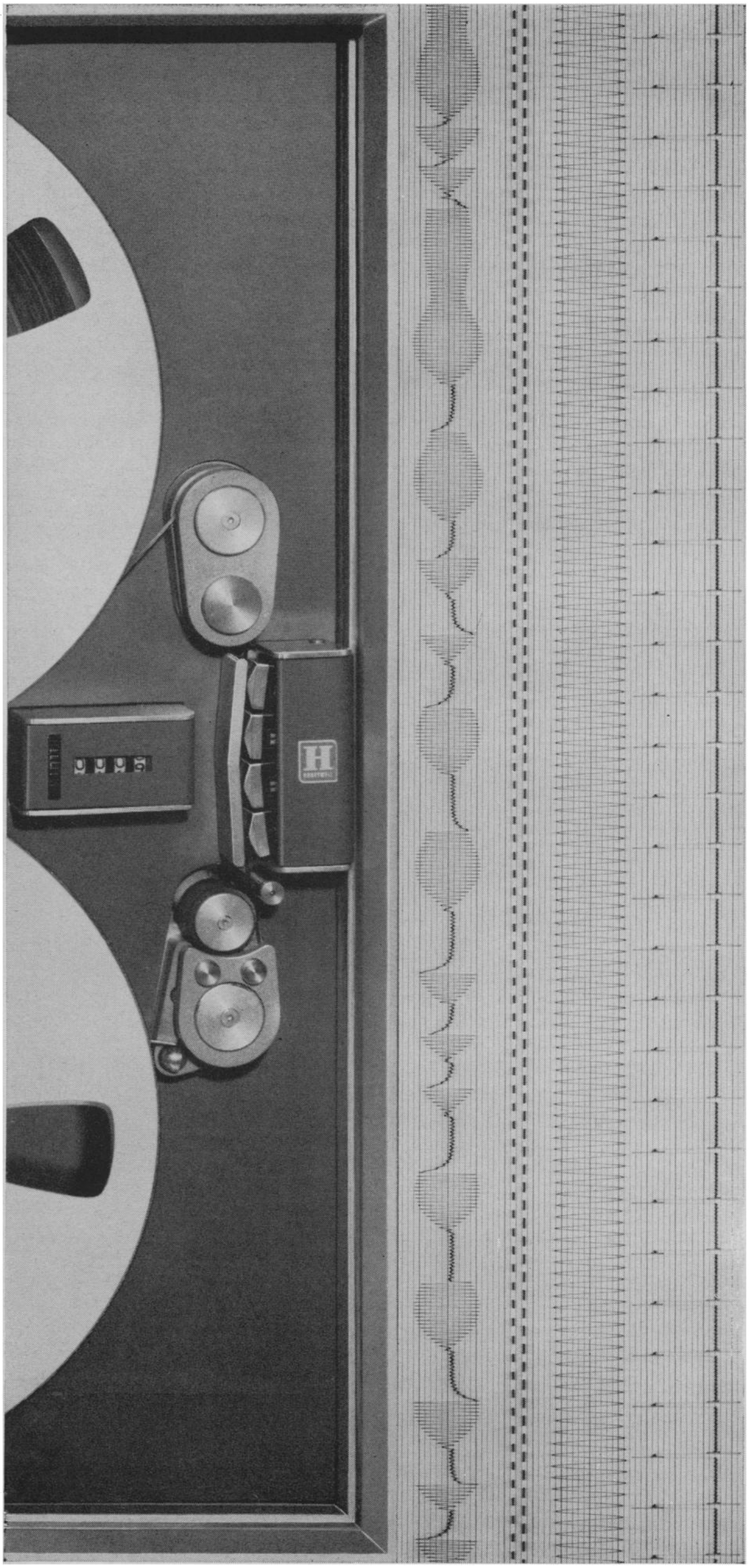
Perkin-Elmer's Model 350 Spectrophotometer is the product of a completely fresh approach to instrument design. Keyed to today's demand for sophisticated analytical and research capability, it combines all the most-wanted features—each at its maximum potential.

In the range from 175 mμ in the far ultraviolet to 2.7 μ in the near infrared, the versatile Model 350 offers superior resolution and photometric precision for a wide range of differential analyses, for color measurement, kinetic studies, optical rotatory dispersion determinations, and other exacting applications. Optically designed for high energy per spectral slit width, with scale expansion and pen response control, it possesses extraordinary microanalytical sensitivity for sample-limited studies—biomedical, forensic and other.

A wide dynamic range of scan speeds and complete selection of recording and sampling accessories enable the Model 350 to meet specialized analytical requirements with ease. For an illustrated brochure with complete description and specifications, write to Instrument Division, Perkin-Elmer Corporation, **910** Main Avenue, Norwalk, Connecticut.



PERKIN-ELMER



# NOW and/or LATER

To get the most out of analog data, you should be able to see it now or see it later, use it now or use it later.

The ideal combination of recording instruments for making the most of your analog data is a Honeywell tape recorder, such as the compact Honeywell 8100 portable instrumentation recorder/reproducer, used with the Honeywell Visicorder Oscillograph.

For immediate readout, the Visicorder gives you an instantaneous record of 1 to 36 channels of data from DC to 5000 cycles per second. A variety of paper speeds from .1 to 160 inches per second gives you the trace resolution you need. Five models of the Visicorder are available.

At the same time, you can record up to eight channels (plus voice and compensation) of data up to 10,000 cycles on the 8100 portable. Later on, you can play selected portions of your data into the Visicorder. Four tape speeds (1⅞, 3¾, 15, and 30 ips) give you record and playback versatility for whatever frequency you're recording.

In the Honeywell 8100, several head and tape configurations are available (including IRIG). All models have a built-in calibration panel, automatic switching of center frequencies, and a new, improved tape drive that cuts flutter to a minimum and eliminates tape breakage. A built-in monitor scope and voice channel are optional. In addition, Honeywell manufactures complete laboratory tape systems with capacities of up to 60 channels on 2-inch tape.

For complete information about the Honeywell 8100, the Visicorder Oscillograph, and other recording equipment, contact your nearest Honeywell office, or write: Honeywell, Denver Division, Denver 10, Colo. Or call us direct at 303:794-4311. In Canada, contact Honeywell Controls, Ltd., Toronto 17, Ontario.

**DATA HANDLING SYSTEMS**

**Honeywell**

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Not a youngster in the group. All are experienced engineers with Bachelor's Degrees. Many have Master's. Some PhD's. They're the 83 graduates of the Beckman Training Course. They're our new analytical instrument selling team. Our direct sales force. They can be especially helpful in solving your problems because each has worked in laboratories much like yours. Instrument application, they understand. Instruments, they know well. For that's all they have to sell. Test them.

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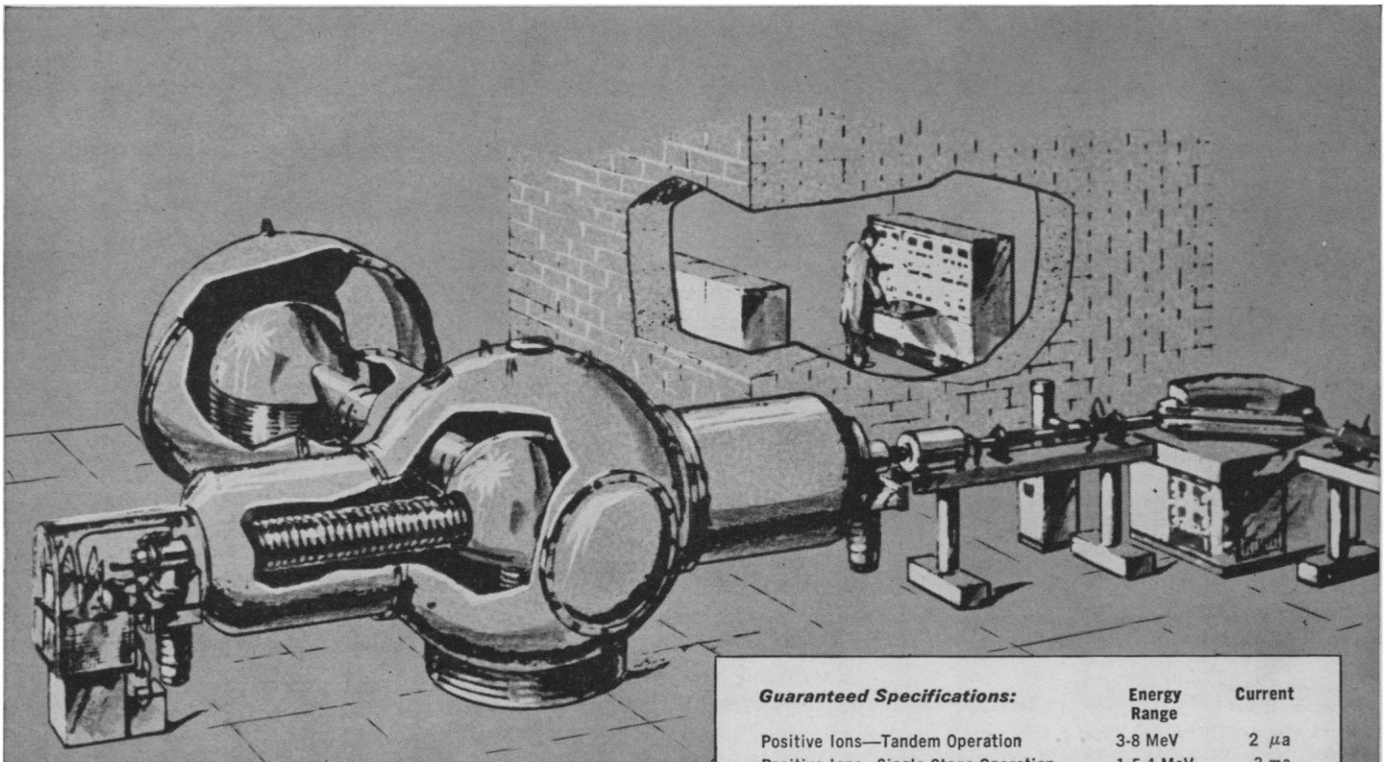
From High Voltage Engineering

# UNIQUE NEW TANDEM ICT ACCELERATOR OFFERS HIGH ENERGY AND VERSATILITY



8 MeV Tandem Unit can be converted to single-stage, positive ion or electron operation

| ***Guaranteed Specifications:*** | **Energy Range** | **Current** |
|---|---|---|
| Positive Ions—Tandem Operation | 3-8 MeV | 2 μa |
| Positive Ions—Single-Stage Operation | 1.5-4 MeV | 3 ma |
| Electron Conversion | 1.5-3 MeV | 10 ma |

***Features:***

Ion source at ground potential

Heavy ion acceleration—multiple stripping

ICT voltage generator has 12 milliampere rating to handle future high current ion sources and targets

*Single-purpose ICT electron accelerator with vertical beam tube and scanner (not shown) will offer 20 ma or 60 kilowatts of electrons at 3 MeV. At this energy, 6 kilowatts of x-rays will be available for a variety of studies in radiation chemistry.

The figures tell the story about the usefulness of High Voltage Engineering's new ICT particle accelerator. Its 8 MeV maximum energy permits nuclear structure research in areas still relatively unexplored. This accelerator system offers the same clean beam, low energy spread, and conversion characteristics associated with Van de Graaff machines.

Used as a neutron source the accelerator can provide a wide range of neutron energies. The single-stage positive ion mode of operation provides intense neutron fluxes using the $Be^9$ (d,n) $B^{10}$ reaction, and also permits studies of reactions with very small cross-sections. The intense electron beam can be used for x-ray production and radiation effects studies.

While the ICT may be used either as a single- or multi-stage accelerator, the high current which is potentially available in tandem or single-stage operation is geared to future ion source and target developments. Current results of our tandem research program have shown the feasibility of intense negative ion sources, and excellent efficiency in conversion to positive ions at the mid-terminal. The ICT Tandem has all the power needed to capitalize on high current developments.

***We have a new General Catalog in which these systems and our entire product line are described. Write for a copy.***

**HIGH VOLTAGE ENGINEERING CORPORATION**
BURLINGTON, MASSACHUSETTS

4 October 1963, Volume 142, Number 3588

SCIENCE

## The Image of the Scientist

That the public image of the scientist is a confused one has often been remarked. The confusion undoubtedly results in part from the speed with which the scientist's role in society has been changing. Most adults grew up when the ties between science and military affairs were not nearly so strong as they are now, when governmental support for science and interest in scientific matters were far weaker than they are now, when outer space could be dreamed about but not probed and entered, when the fruits of science were beneficial or neutral, but not to be feared as many people fear them now.

In time, and with better science education in schools and through the public media, much of the confusion can be cleared away, and most scientists seem to agree that the task of giving the public a better understanding of science is worth a lot of hard work.

But the clarification will apply chiefly to science and much less to the scientist as a person. For, as a person, he is usually out of sight of most of the public, and even when he appears he does not seem to fit the standard American pattern. In many ways he does not match that pattern, and even when he does the match is likely to go unrecognized. Several years ago David McClelland and his co-workers questioned a sample of small-town residents to determine the factors on which they based their ratings of personal achievement. One that loomed large was the extent to which a person had risen above his background. The son of a janitor who becomes a banker gains greater esteem than the son of a banker who follows in his father's footsteps. Many scientists have risen above the occupational status of their fathers, but they are such a mobile lot that few of their neighbors have any idea of the family backgrounds from which they came.

All in all, the scientist frequently is a "different" sort of person, but he probably fits the American ideal of a successful, contributing member of society better than his confused public image does. The degree of fit, however, is not generally recognized because for many Americans he is only an image and never a reality in the sense that the local doctor, lawyer, banker, and merchant are living realities. His works may be feared, appreciated, or ignored, but he remains a dim figure in the background. The use of Swiss cheese, French perfume, or a German automobile gives one little knowledge of the inhabitants of the lands from which these goods were imported; the use of antibiotics, synthetic fibers, or textbooks gives one little knowledge of the scientists whose work made possible their production.

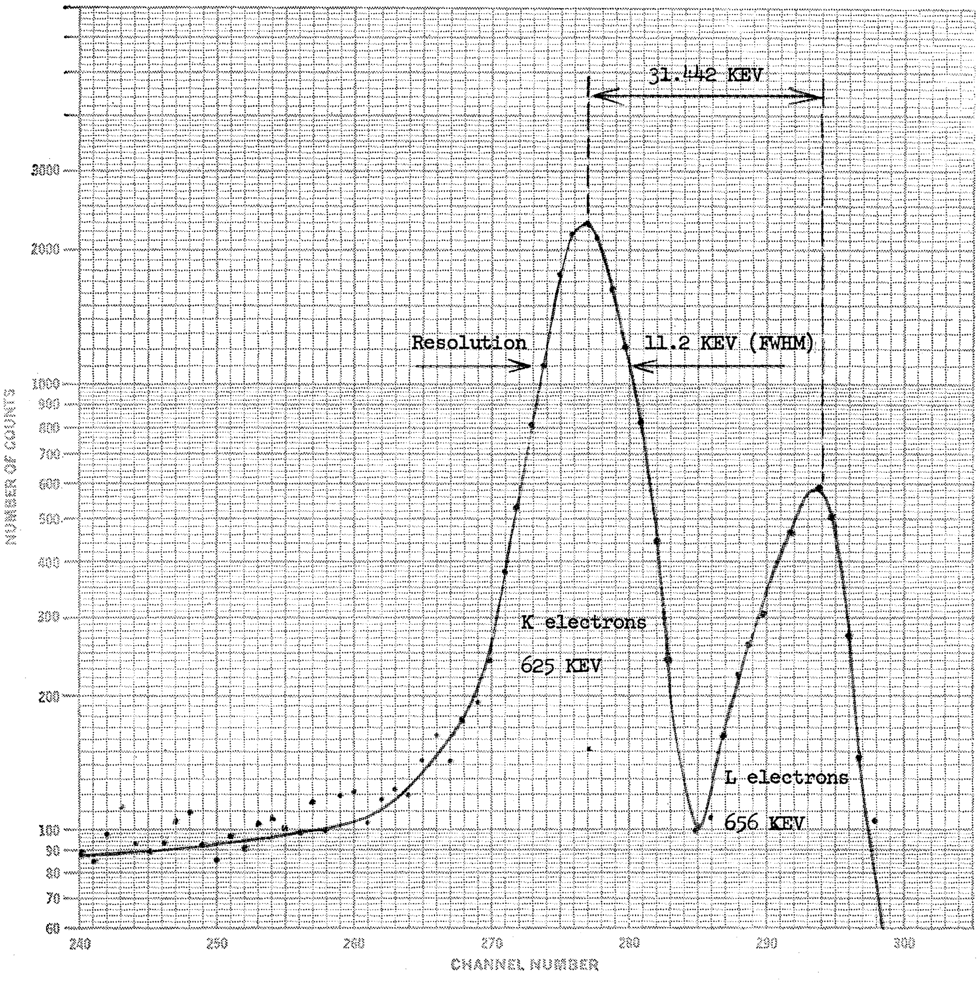
Biographies, of which there have been some good ones, public lectures, and a rare motion picture or television program partially bridge the gap. But it seems likely that the image of the scientist will remain pretty unclear for most people. If this seems inevitable, why not stop worrying about the matter? In so far as they can be divorced, public attitudes toward science are more important than attitudes toward scientists. It is more useful for the public to have a fair understanding of science than an accurate knowledge of the personal characteristics of scientists. And it is more worth while for scientists to help develop an understanding of their work than to try to improve their own image.—D.W.

**Spectrum of K and L conversion electrons from Ba$^{137m}$**

**Conditions:**
**Li-drift detector**
**3 mm thickness**
**56 mm$^2$ active area**
**300v bias**
**0.5 microsec. time constant**
**Room temperature**

**Source:**
**Cesium-137**

**Pulse Height Analyzer:**
**TMC Model 404-6**

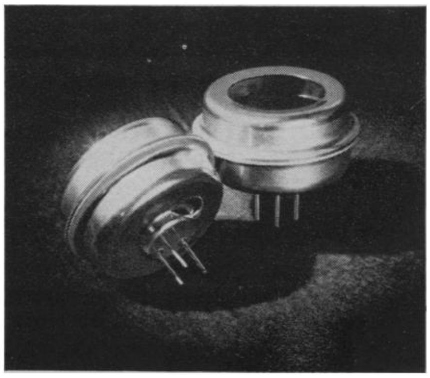


# Don't believe our new solid state detector brochures

***(This curve is the latest word)***

At least don't pay attention to the part that says resolution is "better than 20 KEV" for the new Lithium Ion Drift Detector (some even said 30 KEV). Instead look at the resolution shown in the curve above. It is 11.2 KEV (FWHM) — **at room temperature** — or what we should have called "better than 12 KEV". The rest of the information in the folder is correct. Window thicknesses from 25-50 microns and deep depletion regions combine to give linear response over a wide range of energies . . . leakage is less than 2 microamperes at 100 volts . . . prices are sensible . . . and the detectors are on the shelf.

The description of the new Double Diffused Planar Passivated Detectors for low energy charged particles was correct. They have dead layers of less than a micron. A new patented passivation technique gives them much higher resistance to fingerprints, moisture, gases and other environmental problems. It also gives them high resolution and low leakage current that is shown in a curve provided with each detector. Furthermore, the detectors are fully guaranteed for six months.



*Passivated Detectors — Series, sizes and natural alpha resolution ranges:*

Series A—5mm dia.: R-20 KEV (A-1), 20-50 KEV (A-2), 50-100 KEV (A-3)

Series B—10mm dia.: R-25 KEV (B-1), 25-50 KEV (B-2), 50-100 KEV (B-3)

If you'd like a copy of the latest brochure contact the nearest TMC office, or write Technical Measurement Corporation, 441 Washington Ave., North Haven, Connecticut, Tel. 203 239-2501.

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**DOMESTIC:** Gardena, Calif.; San Mateo, Calif.; La Grange, Ill.; Silver Spring, Md.; Stoneham, Mass.; White Plains, N. Y.; Oak Ridge, Tenn.; Dallas, Texas.

**IN CANADA:** Allan Crawford Associates, Ltd., 4 Finch Avenue, W., Willowdale, Ontario, Canada.

**IN EUROPE:** Technical Measurement Corporation, GmbH, Mainzer Landstrasse 51, Frankfurt/Main, Germany.

**IN JAPAN:** Nichimen Company, Ltd., Muromachi, Nihonbashi, Chuo-Ku, Central P.O. Box #1136, Tokyo, Japan.

TMC

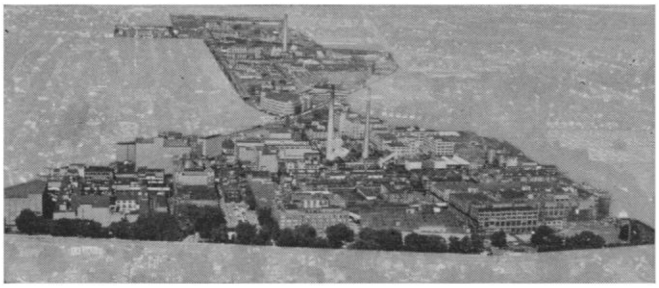
**TECHNICAL MEASUREMENT CORPORATION**

# Kodak advertises:

**why the new KODAK EKTACHROME MS Film . . . that oldtime physics, which is sometimes good enough for us . . . why some people journey to Rochester**

## No longer particularly narrow

Several parcels of farm land that George Eastman began picking up on the outskirts of Rochester in 1890 now look like this:



The site is principally devoted to the manufacture of photographically sensitized goods, with whatever supporting activity seems advisable. The scale of operations, as you will note, is more than trivial. While much of the output does indeed get used for trivial purposes (such as reminding you many years from now of the red and gold on an autumn day when the children were little), more and more of it lacks any connection with frivolity.

Few men have the knack of making a good piece of color film—far fewer than can sew a good overcoat or brew a good glass of beer. As a matter of fact, not a single man in the world knows all by himself how to do it. Only the gigantic organization knows. The people constituting the organization spend their time at small tasks, like broadening the exposure latitude. It was quite narrow when color film first became important.

Today on an instrumentation range when the button is pressed that makes the thingamabob go off and simultaneously starts the 31 movie cameras that will show afterwards what happened, the thingamabob might be sadly wasted if unanticipated light levels resulted in bad underexposure or overexposure. One 16mm, 35mm, and 70mm color film that we endowed with much tolerance against this risk is now being superseded by another with more tolerance. The new one, KODAK EKTACHROME MS Film, can stand four stops $(2^4)$ of underexposure and two stops of overexposure and provides better resolution of fine detail than the older film.*

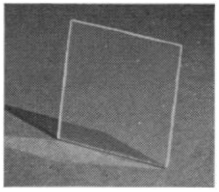
Note that the concept of underexposure and overexposure implies the possibility of a most admirable on-the-nose exposure. As for the two ends of the tolerance curve and how good the results must be to get inside them, one places one's trust in an expert, much as one trusts one's tailor or brewer.

*One's consultant on* these *matters is Eastman Kodak Company, Photorecording Methods Division, Rochester 4, N. Y.*

## Infrared advantageously reflected or refracted

A gnat can fascinate as much as a hippopotamus. Though the polycrystalline infrared media business is considerably smaller than the film business, it continues to yield its own satisfactions. To our four KODAK IRTRAN Optical Materials, we are now able to add IRTRAN 5. The new one commends itself, among other merits, for *reststrahlen.*

Being only a manufacturer instead of an institution of learning, we try to avoid robbing academic circles of too many scholars who can invoke the Fermi surface in discussing ionic crystals that behave like metals in the extent to which they reflect radiation of certain long wavelengths. The monumentally casual and clever oldtimer R. W. Wood simply tells us in his *Physical Optics* that in 1897 Rubens and Nichols worked out a scheme for using several bounces off a crystal to attenuate wavelengths subject to simple Fresnel reflection (e.g., $(4\%)^3 = 0.006\%$), so that only the metallically reflected infrared bands remained; hence, *reststrahlen.* A thin plate of KODAK IRTRAN 5 Optical Material, largely MgO, effectively isolates 15μ - 25μ by one bounce under the right conditions.



On the other hand, the transparency you see here is good from 0.5μ to 8μ, without the water band at 2.8μ. Thermal conductivity exceeds that of any of the other IRTRAN materials by several times. Its dispersion suggests pairing with some of the others to make achromats.

*Apparatus and Optical Division, Eastman Kodak Company, Rochester 4, N. Y. can send much data about* IRTRAN *materials. If you would rather have real infrared lenses than data and can contrive to avoid the need for achromatism, a purchase order would probably result in shipment within a week of any of the following* IRTRAN *2* f/*1 menisci, which transmit 1μ - 14μ and are very rugged thermally, chemically, and mechanically:*

| | EQUIVALENT FOCAL LENGTH (mm.) | MEASURED BLUR CIRCLE* (mm.) | ** |
|---|---|---|---|
| 1. IR-100 | 25.2 computed at 1.5μ<br>26.4 computed at 10μ | 0.36 | $ 77 |
| 2. IR-101 | 25.4 computed at 3μ<br>26.7 computed at 10μ | 0.15 | $235 |
| 3. IR-301 | 76.2 computed at 4.26μ<br>79.5 computed at 10μ | 0.38 | $395 |
| 4. IR-200 | 50.6 computed at 1.5μ<br>53.8 computed at 10μ | 0.61 | $168 |
| 5. IR-201 | 48.8 computed at 4.26μ<br>50.9 computed at 10μ | 0.20 | $325 |

*diameter of axial image of point source at which measured intensity drops to 5% of center peak intensity, for 2 - 4.5μ range.

**net price each in 1-10 quantities, subject to change without notice.

## Light-sensitive lacquers in spray cans and seminars

You can now buy light-sensitive lacquer in 1-lb spray cans. After a 10-min. bake at 140°F, you expose under your photomaster to a strong u-v source. Where the u-v can get through to polymerize, a subsequent wash with an organic solvent leaves the coating in place and strongly resistant to etchants for the underlying metal. Where the master has shielded from u-v, the unpolymerized lacquer is dissolved so that the etchants can dig there. Later another solvent removes the polymerized coating.

The product is called "Spray Resist Type-P." There is also a "Type-M." The former generally works best for copper, copper alloys, and anodized aluminum; the latter, for all other metals.

*Please send us no orders for such cans. Drop a postcard of inquiry to the manufacturer, Industrial Chemical Specialties Corporation, 79 Wall Street, New York City 10005.*

These lacquers sound as though they might be our celebrated KPR and KMER. Wrong. KPR and KMER are merely what we sell I.C.S. to make *their* products with. Get the distinction?

The smallest quantity in which we put up KPR and KMER is a full quart. That way you still have the problem of spray equipment, the problem which I.C.S. solves for you so simply. If it's problems you wish to grapple with, we can introduce you to a whole seminarful in the wise use of photo resists. From time to time we invite a few dozen individuals to spend two days in Rochester listening to us and each other bat around helpful hints on all the aspects—the optical considerations, what the photo-master should be like, metal preparation, number and thickness of coats, baking recipes, equipment for exposing and developing, etchants, etc.

*Would you be interested? If so, drop a note to Eastman Kodak Company, Graphic Arts Division, Rochester 4, N. Y. If you don't already know that these problems are worth grappling with, we hesitate to urge you to ask for the time and travel money.*

---

*The user can run the old (EKTACHROME ER Film) head-to-tail with the new in his processing machines.

earth and its history. While such a definition includes almost all scientific endeavors, only four essential aspects related to the marine environment were considered at the symposium: (i) the concentration of elements in the shell and soft parts of marine organisms; (ii) the production of compounds by organisms during their activities; (iii) the fractionation and separation processes which occur in the marine environment; and (iv) marine biogeochemical cycles.

Little is known about the spectrum of trace elements in carbonate shells; most of the information concerns strontium and magnesium. It is known that the uptake of these two elements is affected by the biochemistry and growth stage of the organism and the crystal phase of the shell, as well as by the temperature, chlorinity, and possibly the total chemistry of sea water. In addition, the substrate upon which the organisms grow plays a vital role in the entire system.

Since trace elements are an integral part of the mineral in which they occur, one must know all the mineral species which are precipitated by marine organisms. Little information is now available on this point. This is true even for the "extensively" studied organisms which secrete carbonates. Relatively recent investigations on the organic matrices of mineralized carbonate shells indicate that their physical structure and amino acid residues can be utilized to define the biochemistry of species, as they are affected by ecologic factors. Moreover, preliminary studies indicate that protein chemistry may be a controlling factor in the formation of particular mineral phases, that is, calcite or aragonite. In this type of investigation knowledge of the trace-element chemistry of the soft parts and body fluids is essential because some are involved in the physiology of the organisms as well as affecting the chemical processes in the ocean. Information obtained from such studies may aid in tracing the biochemical evolution of marine organisms and may be used for monitoring the temperature, chlorinity, and total chemistry of the ancient oceans, and for distinguishing between original and altered composition of fossil skeletons.

Two basic questions arise in the study concerned with the organic content of both sea water and sediments. What is present? What function does it have? Reference to the literature will disclose an extensive bibliography of description: determinations of the organic carbon and nitrogen content of sea water and sediments; correlations between organic matter and sediment particle size, or with plankton bloom; variations of organic matter, at different depths, in both sediment and water in some environments. These studies, even with their shortcomings, have provided the groundwork for the future. With the advent of more sophisticated techniques such as mass spectroscopy and chromotography, the scientist has been able to ascertain the presence of carbohydrates, proteins, fatty acids, hydrocarbons, and other compounds in sea water and sediments. However, present analytical knowledge is inadequate for determining some of the individual compounds and a serious attempt is being made to obtain the necessary information.

Organic matter in sea water is present in dissolved form, in particulate form, and in the living organisms. In the sediments it is present as discrete particles, living organisms, dissolved in the interstitial water and also associated with the inorganic minerals present in a manner not yet thoroughly understood. It ranges in type from that which is extremely unstable and that which is readily utilized by marine organisms all the way to highly stable products which have been termed kerogen or described as "lignin-like."

Dissolved organic matter in water has usually been estimated at 1 to 2 milligrams per liter with values of greater than 5 milligrams per liter in some bodies of water. In sediments the average amount of total organic matter is estimated at 1.5 percent or less. These represent relatively low concentrations but at least part of the organic matter is metabolically active, thus being a very significant component.

While organic matter acts as an energy source for marine organisms, especially microorganisms, in both water and sediments, the details of this system are not yet known. The rates of turnover of biologically utilizable organic compounds are of primary concern for the elucidation of energy cycles in the environment. An intimate relationship exists between the organic matter, the minerals present, and the bacteria. This affects not only the living population of any portion of the sea floor, but also the alteration of the sediment itself. Thus, sediments begin their alteration or diagenesis simultaneously with deposition. In addition, it has been demonstrated that the formation of calcite or aragonite is affected not only by the physiology of an organism and the physical factors of the environment around it, but also by the presence of certain organic compounds. Certain metals may also be accumulated in sediments and shells by the presence of specific organic compounds and by living organisms, or they may be precipitated by microorganisms.

Studies concerning the abundance and fractionation of isotopes in the sea and its contents are of great and growing importance; most investigations have been concerned with hydrogen, carbon, and oxygen. Both hydrogen and oxygen isotopes may be useful tracers of water masses, but from the standpoint of oceanic biogeochemistry a thorough study of the isotopic effect of these three elements ($H^1$ and $H^2$, $O^{16}$ and $O^{18}$, $C^{12}$ and $C^{13}$) will aid in studying biochemical processes in the marine environment.

For instance, the isotope effect of carbon is extremely useful in photosynthesis investigations because the extent of fractionation indicates activity. It is also possible to use this effect as a tool in studying carbonate precipitation, the decomposition of marine organic material, and the fossilization of carbon.

From the ratios of oxygen isotopes in marine organisms, such as foraminifera and belemnites, ancient ocean temperatures have been estimated. This has been most effectively used for determining oceanic paleotemperatures during the last ice age and during earlier periods.

Oxygen isotopes may also indicate the origin of certain marine calcium carbonate deposits by revealing if they precipitated directly from sea water, if they have passed through the biological cycle, or if they have been reworked from earlier deposits. In addition, fractionation studies between mineral phases can help in understanding the origin of authigenic feldspars. In addition to carbon, hydrogen, and oxygen, another isotope, silicon, is important because it may indicate the source used by organisms in the formation of their skeletons.

Many elements have a wide variation of concentration with depth of water in the sea. For instance the concentration of barium, mercury, the rare earths, radium, uranium, and others is 2 to 4 times greater at depths below 1 to 2 kilometers than at the surface. A common reason for con-

centration at depth appears to be an extraction of the elements in question from solution in the surface layers of the ocean by living organisms, which upon death sink into the deeper layers or to the bottom. During this process decomposition takes place and the elements are entirely or partially released into solution.

Copper, nickel, and zinc appear to have uniform concentrations from the surface of the water to the bottom. However, these and other trace elements are sensitive to the presence of organic matter, thus, the published values may not be real. For instance, a column extraction of zinc does not equally absorb three or four of the various species present. Also, certain organic complexes of zinc are known to exist in the sea and these are not generally measured by the methods used.

Although in recent years there has been remarkable advancement in oceanic biogeochemistry, answers to many presently known problems are still lacking and continually elude the scientist. Continued development and refinement of analytical methods are needed, and caution should be exercised when applying a method to one substrata which was devised for another. It is also essential that more data be obtained by existing methods. This naturally requires that samples and data be made available to laboratory specialists by seagoing oceanographers.

Additional information is required on the trace element composition and mineralogy of shells and soft parts of organisms. Rather than obtaining isolated data on a few shells per species, it is essential to collect enough statistically valid information to permit a knowledge of concentration ranges and of their relations to biologic and ecologic controls. It is also necessary to know more about the organic composition of sea water and sediments, not only the dissolved organic fraction in water but also the particulate fraction. Attention must be directed not only to the rarer components and those easy to analyze but also to the mass of the organic material; these are both the original and decomposition products resulting from the environmental history. It is also important that molecular determinations be quantitatively related to the total organic carbon present.

A greater potential lies ahead with further studies on variations in isotope abundances and fractionation processes. These must be investigated in natural waters, in the shells and soft parts of organisms, in inorganically deposited minerals, and in the atmosphere. Data on the presence and availability of nutrients and biologically essential elements in time and space are required as well as on the mineralization and concentration by microorganisms during diagenesis. After all, biological processes are the key to biogeochemistry and the mechanisms concerned.

When considering the development of both laboratory and field experiments it becomes apparent that the growing of organisms under controlled conditions and under close observation must be expanded. Investigations should be designed not only for correlation but also to determine the various mechanisms of inclusion. Likewise, experimental techniques can aid in separating the innumerable and seemingly unfathomable interrelationships which the natural environment portrays when the incorporation of organic material in sedimentary deposits is studied. Simple experiments, increasing in sophistication with time, may well point toward basic processes.

The setting up of bacteriological experiments in order to determine how the environment affects the bacteria and vice versa are of prime importance. Laboratory work may indicate how bacteria function in decomposing marine organic matter and ultimately produce the large mass of highly stable organic compound present in sediments. Likewise, experiments should be devised where recycling processes and rates of cycling can be obtained. Problems concerning the isotope effect, such as degradation of organic compounds, carbonate precipitation, and photosynthesis and its associated problems in the sea, may be answered by experimental means.

Finally, we should combine the analytical data from natural samples with the understanding obtained from experimental endeavors, expend much effort in thought, and arrive at logical, reasonable conclusions.

The programmed participants in this symposium were: F. F. Koczy, H. A. Lowenstam, L. J. Greenfield, G. O. S. Arrhenius, C. H. Oppenheimer, J. R. Vallentyne, R. G. Bader, S. Epstein, I. A. Breger, P. E. Cloud, J. D. Strickland, E. D. Goldberg, and M. C. Sargent. In addition, many specialists from various disciplines were invited and they also participated. This sym-

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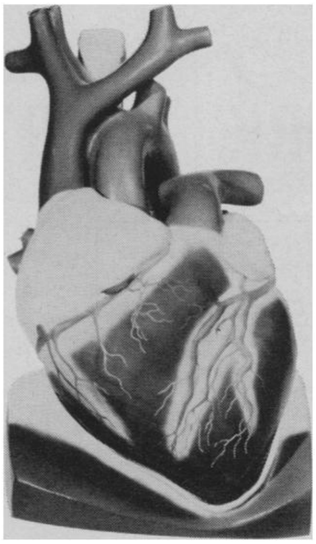

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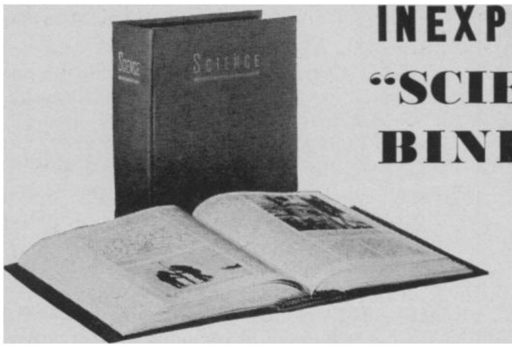

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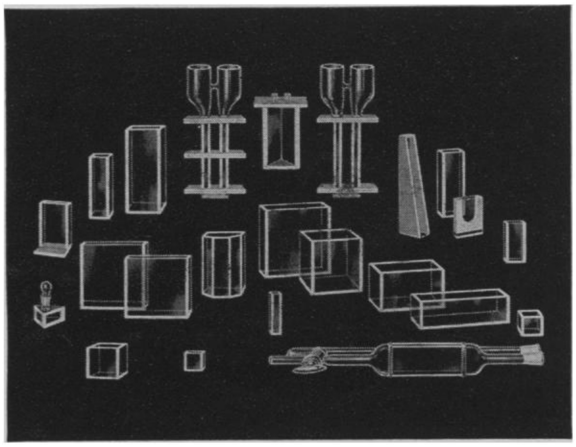

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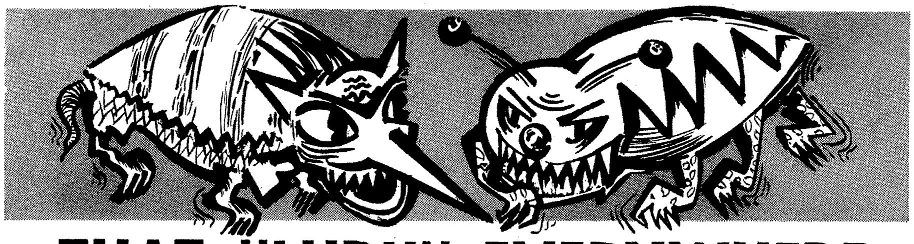

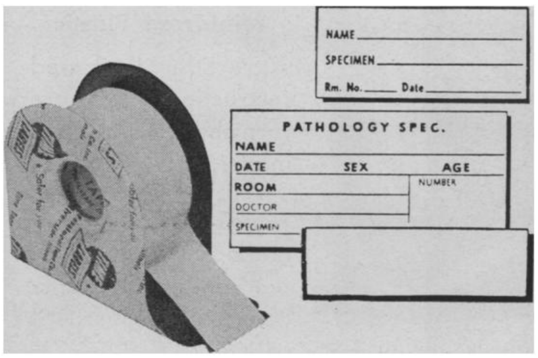

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## Forthcoming Events

### October

*8–10.* **Science and Engineering**, 10th annual symp., U.S. Air Force Academy, Colo. (Maj. J. Shafer, RROND, U.S. Office of Aerospace Research, Washington, D.C.)

*8–11.* **Electromagnetic Relays**, intern. conf., Sendai, Japan. (C. F. Cameron, School of Electrical Engineering, Oklahoma State Univ., Stillwater)

*8–11.* American **Roentgen Ray** Soc., Montreal, P.Q., Canada. (American College of Radiology, 20 N. Wacker Dr., Chicago 6, Ill.)

*9.* American Acad. of **Arts and Sciences**, Brookline, Mass. (R. W. Burhoe, American Acad. of Arts and Sciences, 280 Newton St., Brookline Station, Boston, Mass.)

*9–11.* **Aerospace Electronics**, exposition and conf., Los Angeles, Calif. (E. Niles, Aerospace Electrical Soc., 3540 Wilshire Blvd., Los Angeles 5)

*9–13.* **Cytophotometry** and Interference Microscopy, symp., Giessen, Germany. (W. Sandritter, Pathologisches Institut, Justus Liebig Universität, Giessen)

*10–11.* Bioassay and Analytical **Chemistry**, 9th conf., San Diego, Calif. (G. Bucolo, General Atomic Div., General Dynamics Corp., Box 608, San Diego)

*10–11.* **Engineering** conf., Long Beach, Calif. (Natl. Soc. of Professional Engineers, 2029 K St. NW, Washington, D.C.)

*10–11.* **Kidney**, 15th annual conf., New York, N.Y. (Natl. Kidney Disease Foundation, 342 Madison Ave., New York 17)

*10–11.* **Lipid Transport**, intern. symp., Nashville, Tenn. (H. C. Meng, Vanderbilt Univ. School of Medicine, Nashville)

*10–13.* American Soc. of **Clinical Hypnosis**, 6th, San Francisco, Calif. (W. T. Heron, American Soc. of Clinical Hypnosis, 800 Washington Ave., SE, Minneapolis 14, Minn.)

*13.* American College of **Dentists**, Atlantic City, N.J. (O. W. Brandhorst, 4236 Lindell Blvd., St. Louis, Mo.)

*13–17.* **Neurosurgery**, 10th Latin American conf., Buenos Aires, Argentina. (R. Morea, Callao 1685, Buenos Aires)

*13–18.* Society of **Motion Picture and Television Engineers**, 94th technical conf., Boston, Mass. (H. J. Hall, Itek Corp., Lexington, Mass.)

*13–18.* **Plastic Surgery**, 3rd intern. congr., Washington, D.C. (Capt. Joseph Connelly, Bethesda Naval Hospital, Bethesda 14, Md.)

*14–16.* **Geological Sciences**, intern. un-