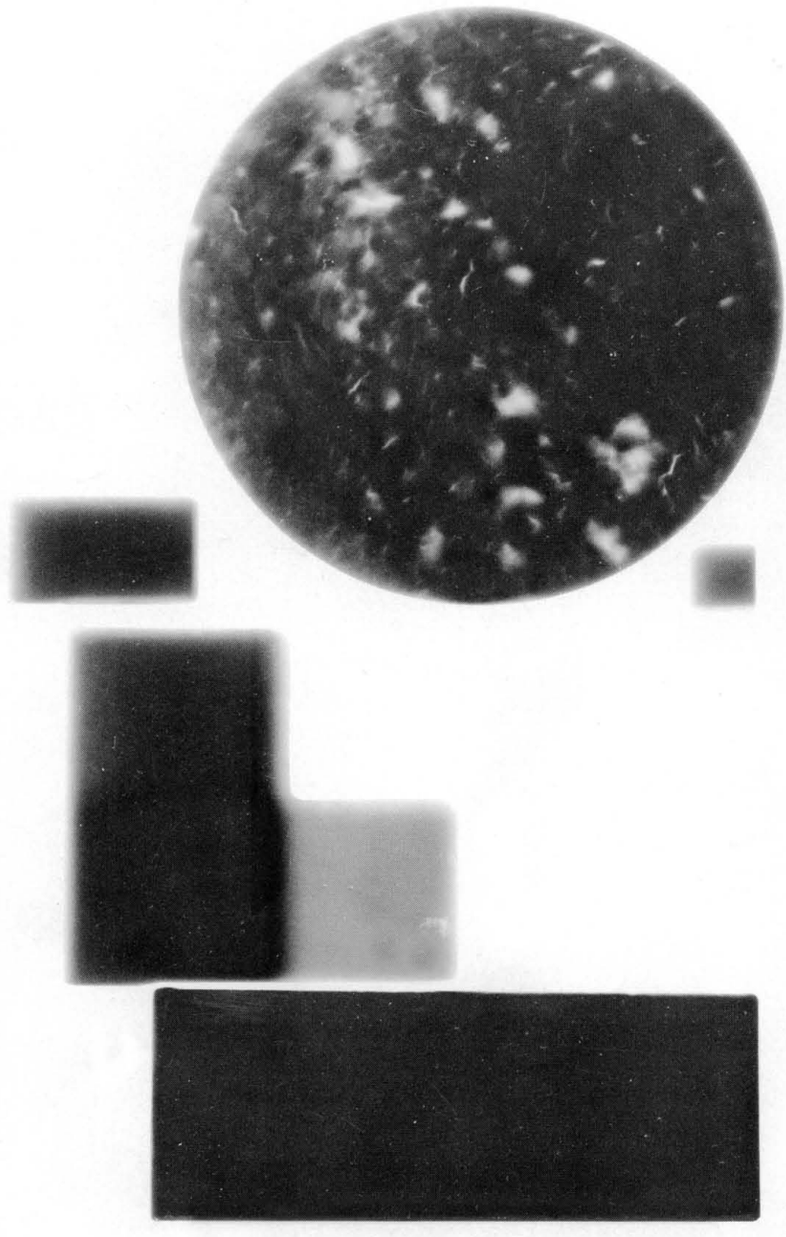
SCIENCE

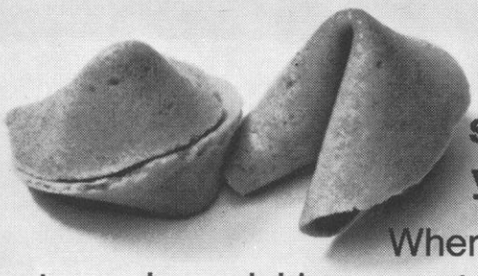
19 April 1968

Vol. 160, No. 3825

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

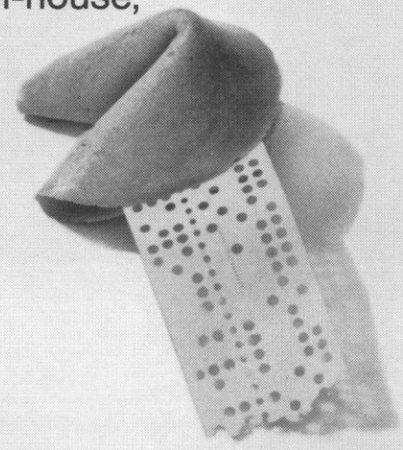


PROTON RADIOGRAPH



A computer is only as good as its software. You're fortunate. Ours makes your life easier.

When you buy your computer, you expect it to work—quickly, accurately and easily. That's why Hewlett-Packard software packages are written—and proved—in-house, by people who are intimate with the hardware. You don't have to be. Just take your choice of FORTRAN, ALGOL or Conversational BASIC. You're on the air fast.



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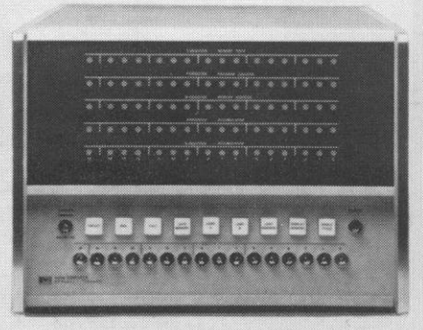
Hewlett-Packard will teach you how to use the software package in two weeks of free classroom training. The same programs and techniques work with any computer in the HP family. We hope you'll join our customers who keep telling *us* about *their* good fortune.

For more information about HP computers and our proved software, call your local HP field engineer. Or write Hewlett-Packard, Palo Alto, California 94304; Europe: 54 Route des Acacias, Geneva.



HEWLETT hp PACKARD

DIGITAL COMPUTERS

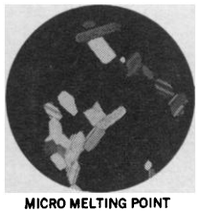
06808

For automated thermal microscopy, just add the new Mettler FP-2 to your microscope

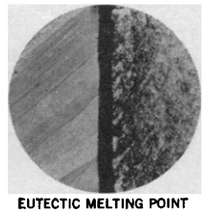
The Mettler FP-2 is an automatically controlled microfurnace and digital indicator for use with standard laboratory microscopes in thermal microscopy. By greatly increasing precision, convenience and temperature control, the system makes the time-honored technique a highly reproducible research and analytical method.

The system makes it easy to carry out studies which were considered difficult, and makes possible many studies which formerly were impossible. It enables the investigator to maintain precise control of sample temperature and to automatically record experimental data without ever looking away from the sample itself.

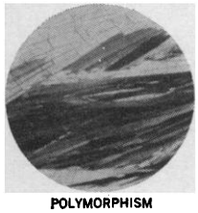
The instrument operates over the range of −20° to +300°C, temperatures suitable for study of fusion phenomena of virtually all organic



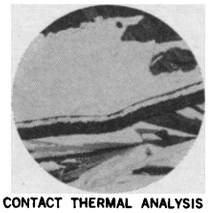
MICRO MELTING POINT



EUTECTIC MELTING POINT



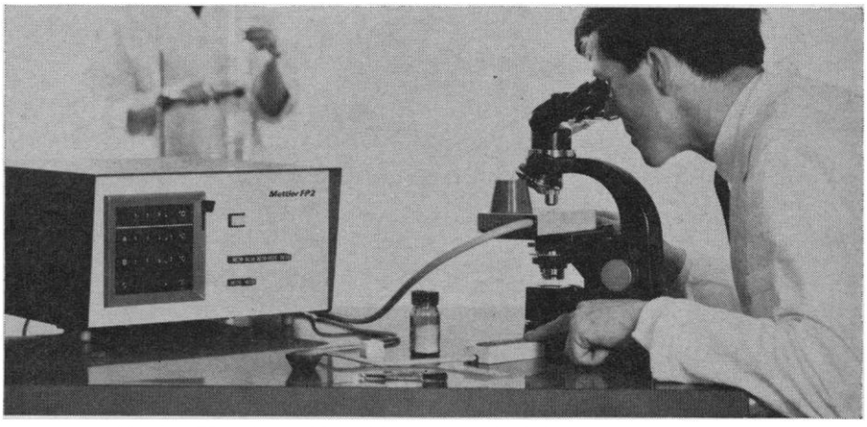
POLYMORPHISM



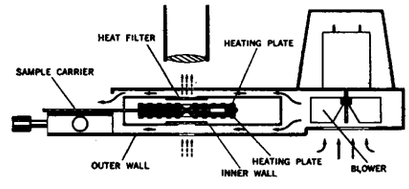
CONTACT THERMAL ANALYSIS

compounds and most inorganics. The system gives the researcher complete control over his sample temperature – increasing at a linear rate, decreasing, or holding at any single temperature. Three heating rates are provided: 10°C/minute for orientation tests, 1°C/minute for routine tests, and 0.2°C/minute for precision measurements to ±0.1°C.

The temperature control system of the Mettler FP-2 combines an electronically regulated temperature program, a platinum resistance thermometer, a low-mass sample chamber for mounting on the microscope



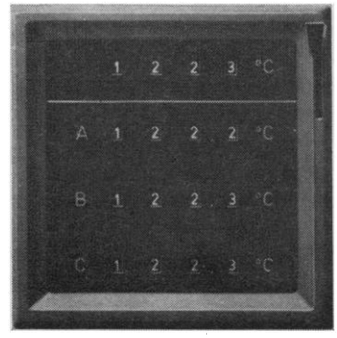
Mettler FP-2 is usable with any standard laboratory microscope



Schematic of sample chamber

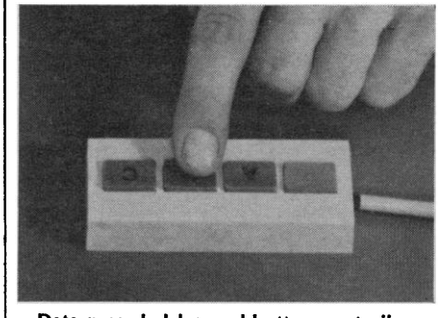
and a remote pushbutton controller for increasing, decreasing, or maintaining the sample temperature at a specific value.

The remote pushbutton controller enables the operator to record the exact temperatures at which any three thermal events occur – beginning of melt, end of melt, phase change, or any of several conditions in the crystallization process. Results are displayed automatically on the digital indicator panel.



Digital readout of analytical data

At no time during critical phase changes is the system operator required to divert his attention from the sample. He can hold the sample in isothermal condition, raise or lower the sample temperature without ever taking his eyes from the



Data recorded by pushbutton controller

microscope. In addition, the digital indicator continuously displays the sample temperature, making it unnecessary for the tedious and continuous observation of the sample during preliminary sample heating.

The Mettler FP-2 maintains control of sample temperature with precision to ±0.1°C. Its temperature program is both lag-free and surge-free, providing the strictly linear temperature advance that is essential for reproducible results.

Request your copy of the new Mettler FP-2 product bulletin and an applications booklet on thermal microscopy. Write Mettler Instrument Corporation, 20 Nassau Street, Princeton, New Jersey 08540.

Mettler®

19 April 1968
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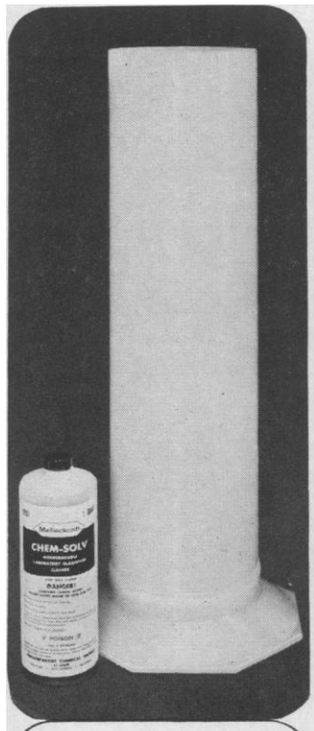
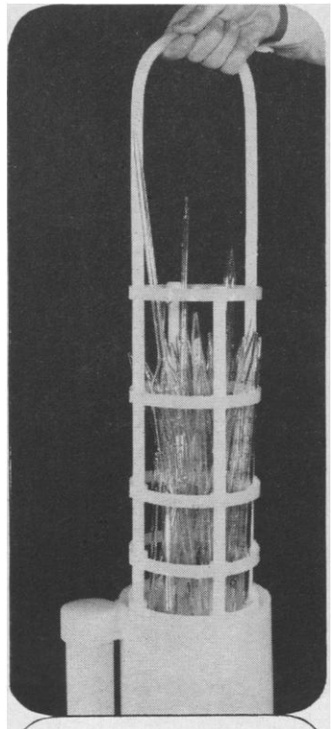
Proton radiograph of reactor-grade graphite (National Carbon type AUC), 10.2 centimeters in diameter and 5.1 centimeters thick. Calibration block consists of polystyrene from 7.0 (white) to 7.5 centimeters thick (almost black). Defects of 2 percent in the effective density are fairly common. See page 303. [A. M. Koehler, Harvard University, Cambridge, Massachusetts]

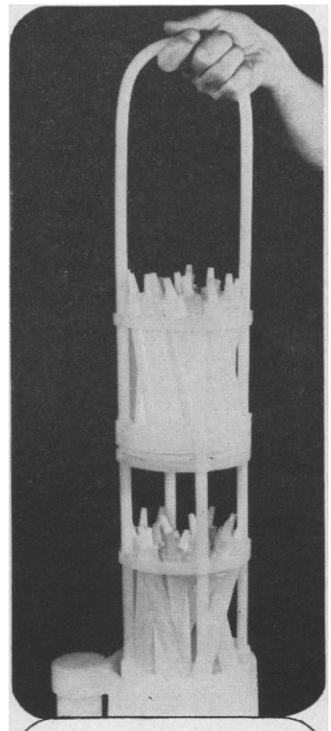
NEW Mallinckrodt system gets pipettes cleaner with no "siphon stall"



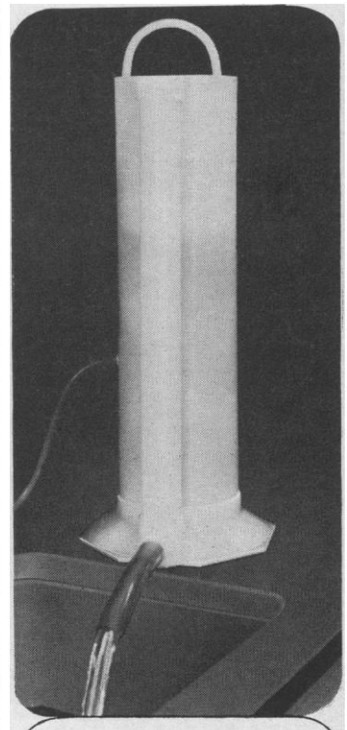
Here's the start of the most efficient pipette washing system ever offered. The Mallinckrodt Pipette Jar with Mallinckrodt Chem-Solv® — an excellent lab cleaner. There's a free Chem-Solv sample packed with every washer.



Unique "open basket" design makes the difference—lets the water swirl freely around your pipettes for dynamic cleaning action. Center rings adjust quickly for optimum spacing. Accommodates pipettes up to 22½" long.



When you're washing smaller pieces, reposition the plastic lid and wash two tiers at once—double the capacity of other systems. Simply lift the open basket to inspect all pieces without handling them.



Exclusive "tube within a tube" siphon system operates smoothly, automatically—over a wide range of pressures and flow rates—without the aggravating "siphon stall" you often get in equipment of older design.

Cleaner pipettes, with far less fuss, and greater economy, too! That's what you get in the new Mallinckrodt Pipette Washing System. Here's a truly automatic system you don't have to watch over—just turn on the water and forget it. Built for years of daily use. Order now from your Mallinckrodt distributor. Or send the coupon for full details, along with our complete catalog of AR® Plastic Labware.

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In hope of doing each other some good

Kodak

Patent lawyers: Besides these three we have some 75 more on the payroll and find that isn't nearly enough. Challenged as to what good they do *you,* the public, they might plead thus:

Among all the things Kodak makes, you may imagine there are hundreds of camera models. Wrong. There are less than 20. They compete against about 330 models offered by others. Those others are pretty quick to send to Washington for all the details in any camera improvement patent that one of those lawyers gets through. That's exactly what Thomas Jefferson and his friends had intended when setting up the U.S. patent system.

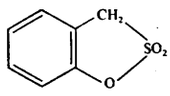
"Aha!" gloats the competitor as he scrutinizes our patent, "I have a far, far better idea than Kodak's." So his lawyer gets him a patent. Perhaps his improvement depends on our improvement. If he therefore asks for a license, he will not find us unreasonable on timing and royalties. And vice versa, we hope.

Which is why, if you don't care for the first 349 models you are shown, there is a 350th. To keep your options wide on products that might affect you even more than cameras, but with stability to support a society beyond old Jefferson's imagination, patent lawyers are in short supply.

α-Chymotrypsin titrator

Emil Thomas Kaiser, Associate Professor of Chemistry and Biochemistry at the University of Chicago, works up new titrating agents for enzymes. We too wish to be known for enzyme substrates. There is quite a difference, though, between Dr. Kaiser's team and us. The old familiar substrates that everybody routinely uses claim their interest less than ours. Their mission is to elucidate and incidentally innovate, ours to supply that others might rely.

In Burlington, Vt. last summer Kaiser spoke on "Enzyme Chemistry of Highly Reactive Cyclic Esters." We struck up conversation. It was about sultones, inner anhydrides of sulfonates, like the one from 2-hydroxy-α-toluenesulfonic acid,



Since this compound attacks a certain serine residue at an active site of the proteolytic enzyme α-chymotrypsin, he wanted us to perform our proper commercial function by offering it for sale. A nitro at the 5-position acts chromophorically and creates a better titrant as 2-Hydroxy-5-nitro-α-toluenesulfonic Acid Sultone. Having gotten the point, we now announce the latter as EASTMAN 10335.* Furthermore we offer the unnitrated sultone as EASTMAN 10333,** as EASTMAN 10231 the 1961 model chymotrypsin titrant N-*trans*-Cinnamoylimidazole (which attacks the same active site but is more restricted in pH range), and as EASTMAN 9601 the uncyclized but otherwise analogously structured chymotrypsin titrant α-Bromo-4-nitro-o-cresol, where Br did what SO_3H now does better.

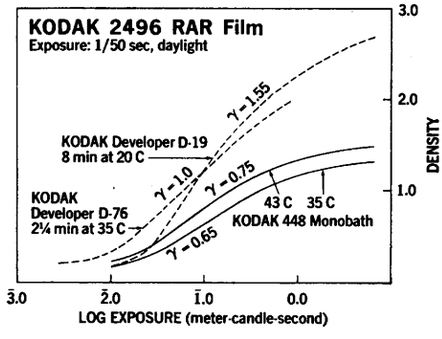
If you were still driving a car that was assembled the day that brominated chymotrypsin titrant entered the literature, your prosperity might be questioned.

Look up J.A.C.S. 89, *460 (1967). Order these or any other* EASTMAN *Organic Chemicals from* **ALLIED/CURTIN/FISHER/HOWE & FRENCH/NORTH-STRONG/SARGENT/VAN WATERS & ROGERS/WALKER/WILL**—*prominent laboratory suppliers all. Send to Distillation Products Industries, Rochester, N.Y. 14603 (Division of Eastman Kodak Company) for List No. 44 and its newest Cumulative Supplement 44-4.*

Sometimes hot solutions, sometimes cold film

KODAK 448 Monobath now comes in a single-solution form that can be used right from the bottle. No more powder to dissolve. A small convenience. Monobath is itself a considerable convenience over separate developing and fixing for 16mm, 35mm, and 70mm film. With the same solution doing both jobs, gone is the carefully taught concern about switching at the right moment from developer to fixer. With KODAK 448 Monobath the processing simply runs to completion. Then the film just sits there awaiting the operator's pleasure to take it out and wash it. If there is no time to wash it and a little stain can be tolerated, the film may be dried and washed later. Control is exercised through temperature. At 35 C, KODAK 2496 RAR Film (ESTAR-AH Base) can be ready to look at in as little as 30 seconds; at 43 C, 20 seconds.

Here is how results compare with two different kinds of conventional development:



The question is whether you need results as superior as the conventional developers can give. This does not mean that photographic quality can be bought only with wet fingers. Where circumstances permit or justify, machine processing can be elected. We can offer plenty of recommendations.

The fastest of today's films aren't intended for immersion in solutions as warm as indicated above, but films trademarked "RAR" are. Other RAR Films both slower and faster than 2496 RAR Film are available. Other, still faster Kodak films are also available for those who need them. (Just as you can buy more horsepower than is good for you, so can you buy too much film speed.)

The trademark "ESTAR" is also significant. Since it became popular on film base for technical work, little has been heard of film's shattering from the cold at high latitudes or altitudes.

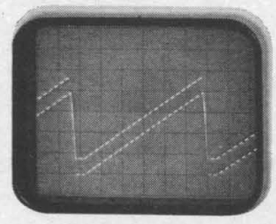
Small conveniences do help, and they do keep coming. For advice on this specialized photography try calling 716-325-2000, ext. 3257, or writing Eastman Kodak Company, Instrumentation Products, Rochester, N.Y. 14650.

*We name it 5-Nitro-3H-1,2-benzoxathiole-2,2-dioxide.
**We name it 3H-1,2-Benzoxathiole-2,2-dioxide.

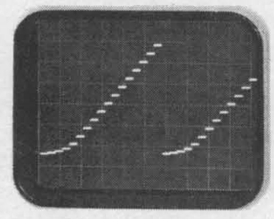
EASTMAN KODAK COMPANY An equal-opportunity employer

4 ways to view displays with the Tektronix Type 564

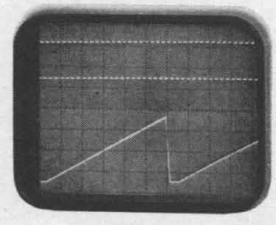
split-screen storage oscilloscope



Entire screen can be used for a stored display.

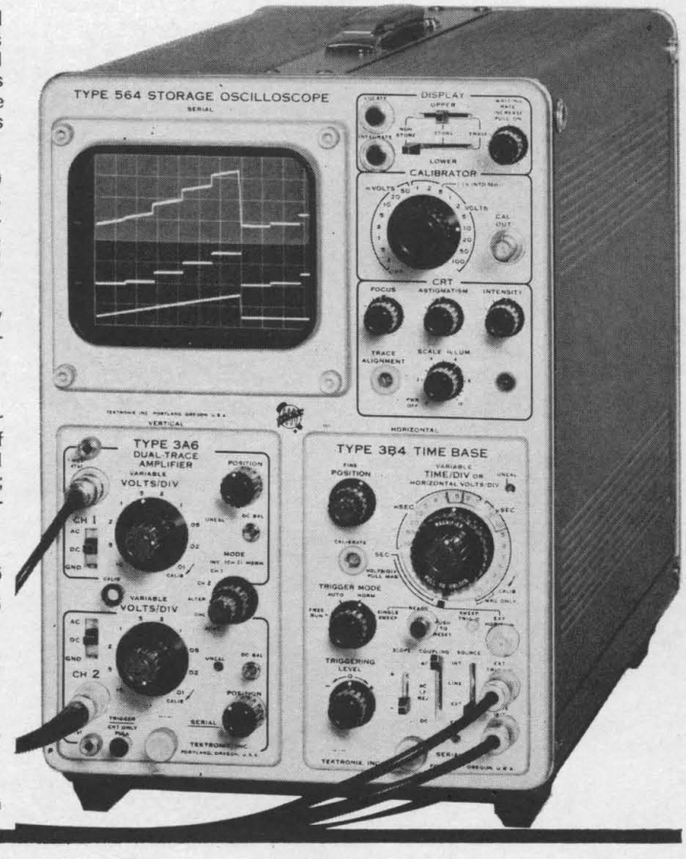


Entire screen can be used for a nonstored display.



Each half of split-screen can be used independently for stored displays.

Either half of the split-screen can be used for a stored display, the other half for a nonstored display. (Shown below).



The Tektronix Type 564 is virtually two instruments in one. It offers all the advantages of a storage oscilloscope plus those of a conventional oscilloscope.

Split-Screen Displays

An unique split-screen display area enables you to simultaneously use either half of the screen for storage and the other half for conventional displays, or use the entire area for stored or conventional displays.

Independent control of both halves of the screen permits you to take full advantage of the storage facilities. For example, you can use half the screen to store a reference waveform, the other half to display waveforms for comparison. You can erase or retain either half of the display area as you choose.

Bistable Storage Advantages

With bistable storage oscilloscopes, such as the Type 564 and Type 549, the contrast ratio and brightness of stored displays are constant and independent of the viewing time, writing and sweep speeds, or signal repetition rates. This also simplifies waveform photography. Once initial camera settings are made for photographs of one stored display, no further adjustments are needed for photographs of subsequent stored displays.

Storage time is up to one hour, and erase time is less than 250 milliseconds. An illuminated 8 cm by 10 cm graticule facilitates measurements and aids in taking photographs with well-defined graticule lines. Adding to the operating ease is a trace position locater that indicates, in a nonstore area, the vertical position of the next trace or traces.

Tektronix bistable storage cathode ray tubes are not inherently susceptible to burn-damage and require only the ordinary precautions taken in operating conventional oscilloscopes.

Plug-In Unit Adaptability

The Type 564 accepts Tektronix 2 and 3-series plug-in units for both vertical and horizontal deflection. Display capabilities of these units include single and multi-trace with normal and delayed sweep; single and multiple X-Y; low-level differential; dual-trace sampling; spectrum analysis, and many other general and special purpose measurements.

Type 564, without plug-in units . . . . . $ 925

Rack-Mount RM564 . . . . . $1025
Similar electrical characteristics to Type 564. 7" high.

Type 3A6 Dual-Trace Amplifier Unit . . . . . $ 525
DC to 10 MHz from 10 mV/div to 10 V/div. 5 display modes. Internal signal delay line.

Type 3B4 Time Base Unit . . . . . $ 425
Sweep speeds from 0.2 μs/div to 5 s/div. Single sweep. Up to X50 direct-reading magnifier extends fastest sweep to 50 ns/div.

U.S. Sales Prices FOB Beaverton, Oregon

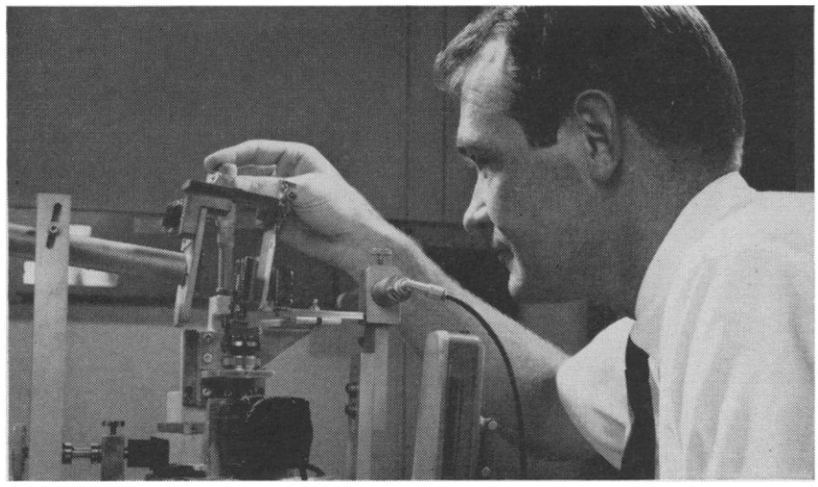
Tektronix, Inc.

For a demonstration, contact your nearby Tektronix field engineer or write:
Tektronix, Inc., P. O. Box 500, Beaverton, Oregon 97005.

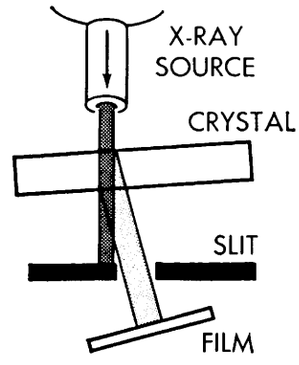
Report from

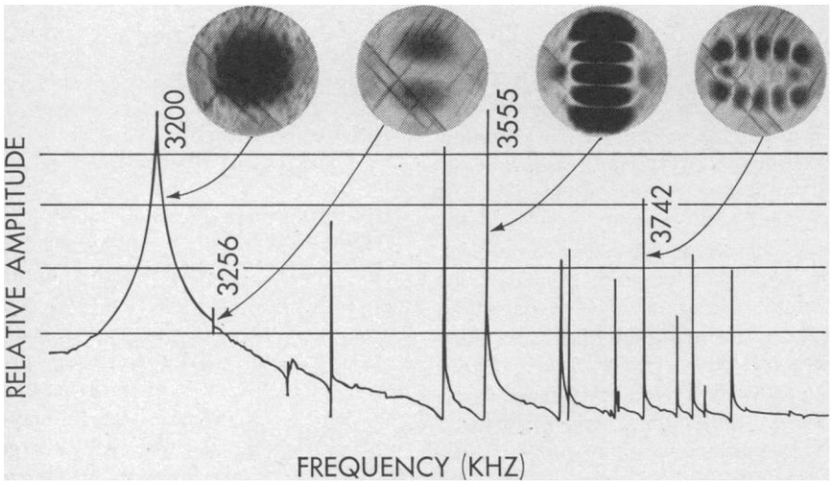
BELL LABORATORIES

The Anatomy of Vibrating Crystals



William J. Spencer with equipment for detecting vibrational modes. Through sloped tube, left, X-rays strike crystal (in frame at center of apparatus). A portion of beam is diffracted by the crystal (drawing, right) and passes through the slit. The main X-ray beam is stopped at the edge of the slit. During exposure, crystal and film are driven from left to right so that entire crystal area is photographed. The X-ray beam is set at a particular angle to the crystal (the Bragg angle), which for good crystals produces a diffracted intensity greater than at other orientations. Vibrating the crystal reduces destructive interference and increases diffracted-beam intensity.





X-ray photographs of a crystal showing four modes of vibration selected from the many modes indicated by the resonance peaks on the curve. Dark areas are due to displacement antinodes in the vibrating quartz disk. Diagonal lines are intrinsic crystal-lattice defects.

In modern amplifiers, filters, and oscillators, piezoelectric crystals are widely used to select signals at certain frequencies. Such crystals —of quartz, for example—provide electronic selectivity because of their ability to convert electric waves into mechanical waves, and mechanical waves back into electric waves, at certain resonant frequencies. For any particular application, the principal resonant frequency is determined by the size and geometry of the crystal, but in addition to this principal vibrational mode, the crystal will vibrate in a number of other modes.

To suppress these unwanted resonances, they must first be identified. And until recently we did this by observing patterns created when a crystal, coated with a fine powder, is vibrated at high intensity. Since the powder collects where the crystal surface is stationary, a vibrational pattern or mode is revealed. But the pattern at such high signal levels may not correspond to the modes produced at the lower signal levels of actual operation.

Recently, however, W.J. Spencer, at the Bell Telephone Laboratories location in Allentown, Pa., has used X-ray diffraction as an accurate and flexible method of observing vibrational amplitude under realistic conditions. The new method depends on the fact that the intensity of diffracted X-rays is extremely sensitive to distortion of the crystal lattice. The transmission of the rays is greater through vibrating regions of a crystal, and this darkens such areas on the X-ray film. Stationary regions are light.

Vibration amplitudes of less than a millionth of an inch are easily observed. Thus, we obtain a quick, sensitive photographic record of displacement associated with any crystal resonance under conditions simulating actual use. This technique helps us design better filters for the Bell System.

Bell Telephone Laboratories
Research and Development Unit of the Bell System

It probably would be useless for us to reiterate here the facts of the population-food-environment crisis which have been so eloquently stated by LaMont Cole, Karl Sax, William Vogt, William and Paul Paddock, James Bonner, and many, many others. Surely, however, there must be some way to make this committee of the National Academy of Sciences aware that the population growth rate *will* reach zero (or, more likely, go negative) in the future regardless of how much support that goal has from people or governments. The question is: how soon and by what means will the growth rate reach zero or go negative? We have just returned from a discouraging day rich in platitudes, fuzzy thinking, technological optimism, and lack of consideration of environmental problems at the "Second International Conference on the War on Hunger." The conference reinforced our belief that the world is committed to the "death rate solution"—one in which population growth ends largely because of a rising death rate. The response of the population committee deepens our feeling of hopelessness. One might have hoped that this committee would feel a duty to get the establishment working on a crash program leading to a "birth rate solution." Instead they produce a pompous commentary on Davis' well-reasoned article. Most of us, gentlemen, do not need reminding about the political realities. Why aren't you, in your position of prominence, doing everything in your power to change them?

PAUL R. EHRLICH
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The letters on population control ignore the second opening in the population pool: death. The current medical attempts to keep people alive forever recall the main reason for burgeoning populations: a drastic decrease in death rates without a corresponding drop in birth rates. So, we will plan to limit births. Fine. Should we then simultaneously encourage research to keep people alive still longer? It seems likely that there is some point where it is best, from a collective view, to let old people die to make room for new, hence more adaptable, individuals. Any serious attempt to curb population must consider this uncomfortable question.

RICHARD LYMN
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Davis makes a compelling case that present family planning programs alone will not succeed in curbing population growth. He calls for expanded social research and experimentation so that governments may take effective measures to influence couples to have small families—the goal being the public control of the size of the population. The same conclusion was reached at the September meeting in Caracas on Population Policies in Relation to Development in Latin America jointly sponsored by the Organization of American States, the Pan American Health Organization, and the Population Council, Aspen Institute for Humanistic Studies with the cooperation of the government of Venezuela. The meeting was attended by 145 representatives of Western Hemisphere countries.

The recommendation was made that "a population policy should not be adopted in an isolated or unilateral fashion, but should be part of the total phenomenon of development . . . a coherent set of decisions making for a rational strategy, adopted by the public sector in accordance with the needs and desires of the community, to develop, conserve, and use human resources by influencing the probable size and growth of the population, its age make-up, mortality rates, the formation and composition of families . . . in order to facilitate . . . economic growth and enable the people to share in the responsibilities and benefits of progress" (*1*). The OAS was asked to provide technical support to the Committee on Inter-American Progress on population trends and variables. So far, Colombia has the most extensive program of population research. Mendoza-Hoyos of the Association of Colombian Faculties of Medicine said, "Population fertility will not be fully understood unless we know the psycho-physiological factors involved in sexual behavior and contraceptive practices. Nor can variations in fertility be understood unless marriage, family, the formation and dissolution of conjugal unions are taken into account. These . . . are determined to a great extent by cultural patterns" (*2*).

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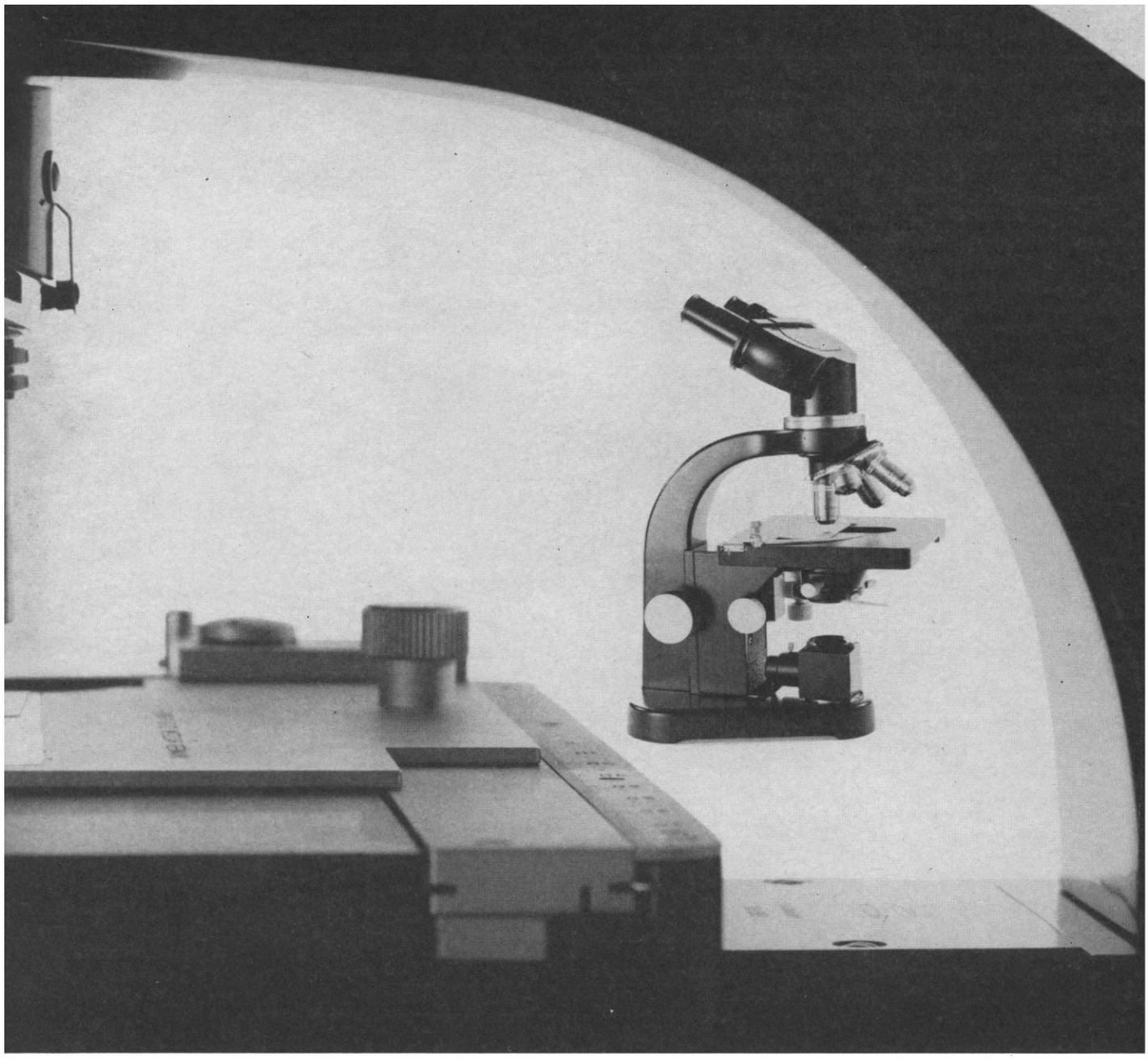
2. H. Mendoza-Hoyos, *Proc. Third PASB Conference on Population Dynamics, June 1967* (Pan American Health Organization, Washington, D.C.).



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19 April 1968, Volume 160, Number 3825 **SCIENCE**

Progress toward Abatement of Air Pollution

For many years air pollution steadily grew more severe. Photochemical smog of the type so prevalent in Los Angeles was noted with increasing frequency in many states. In some metropolitan areas such as New York a different kind of pollution problem arose from interactions involving particulate matter and SO_2. Primary sources of SO_2 are coal and residual oil, both of which often have a sulfur content higher than 2 percent.

During November 1966 an unusual weather condition led to very heavy pollution around New York City. Excessive morbidity and mortality were attributed to the episode. At the urging of Mayor Lindsay the major local electric power utility, Consolidated Edison, agreed to limit the sulfur content of the fuel it burned. Beginning in October 1967 the utility started to use residual oil having a sulfur content of no more than 1 percent. A federally sponsored abatement council recommended that by October 1969 the sulfur content of fuel oil for space heating should be limited to 0.37 percent. However, it was realized that sufficient fuel oil with this low sulfur content would not be available in time. The deadline was accordingly abandoned, but a new one will be set soon.

Standards in neighboring New Jersey are more definite. By May 1968 no fuel oil containing more than 1.0 percent of sulfur may be purchased for use, and the allowable content drops to 0.3 percent by 1 October 1971. The new standards will have sizable economic consequences. Unless desulfurization of flue gas becomes fairly cheap and effective, the use of oil in New York will be curtailed. The cleaner fuel oil will be more expensive, and the oil companies will be forced to build new refining facilities costing hundreds of millions of dollars.

The efforts of the mayor and his pollution control administration have been successful in eliciting the cooperation of other large consumers of fuel besides Consolidated Edison. As a result SO_2 emissions in New York City have already fallen by 25 percent.

Another major area in which progress has been made is that of the control of emissions from automobiles. The principal pollutants from this source are hydrocarbons, CO, and NO. A complex interaction between sunlight, the hydrocarbons, and nitrogen oxides leads to photochemical smog.

As J. K. Patterson has said,* "The unwonted automotive emissions are not the inevitable result of the gasoline engine combustion process." The combustion of gasoline to form $CO_2 + H_2O$ can be carried out, in an automobile, to give very little CO and unburned hydrocarbons. However, "the simplest, lowest cost, most foolproof way of providing flexible engine performance is to supply a little more fuel . . . under some operating modes than would be necessary if the engine combustion conditions were ideal." The automobile manufacturers, under federal pressure, have been finding ways to improve combustion efficiency and ways to suppress the emission of hydrocarbons. Thus the vehicle of 1960, before emission was subject to control, emitted an exhaust containing 3.5 percent of CO and 900 parts of hydrocarbons per million. The 1968 models must meet standards of no more than 1.5 percent of CO and 275 parts of hydrocarbons per million.

If the momentum for abatement of pollution is to be maintained, the public must continue to demand improvements. However, where significant progress is being made, the pollution control agencies and the companies involved merit more recognition and commendation than they have received thus far.—PHILIP H. ABELSON

* J. K. Patterson, "Progress in Conserving the Air," address presented 9 March 1968 in Houston, Texas, before the National Wildlife Federation. Dr. Patterson is Coordinator for Conservation Technology, Esso Research & Engineering Company.

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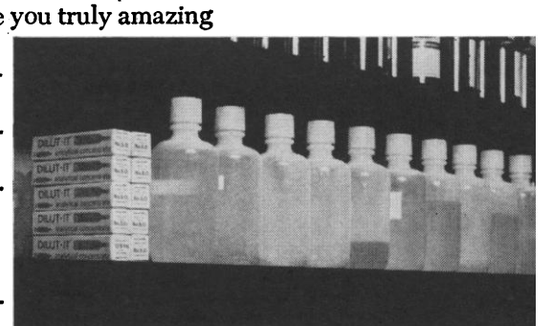

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