SCIENCE

18 April 1969
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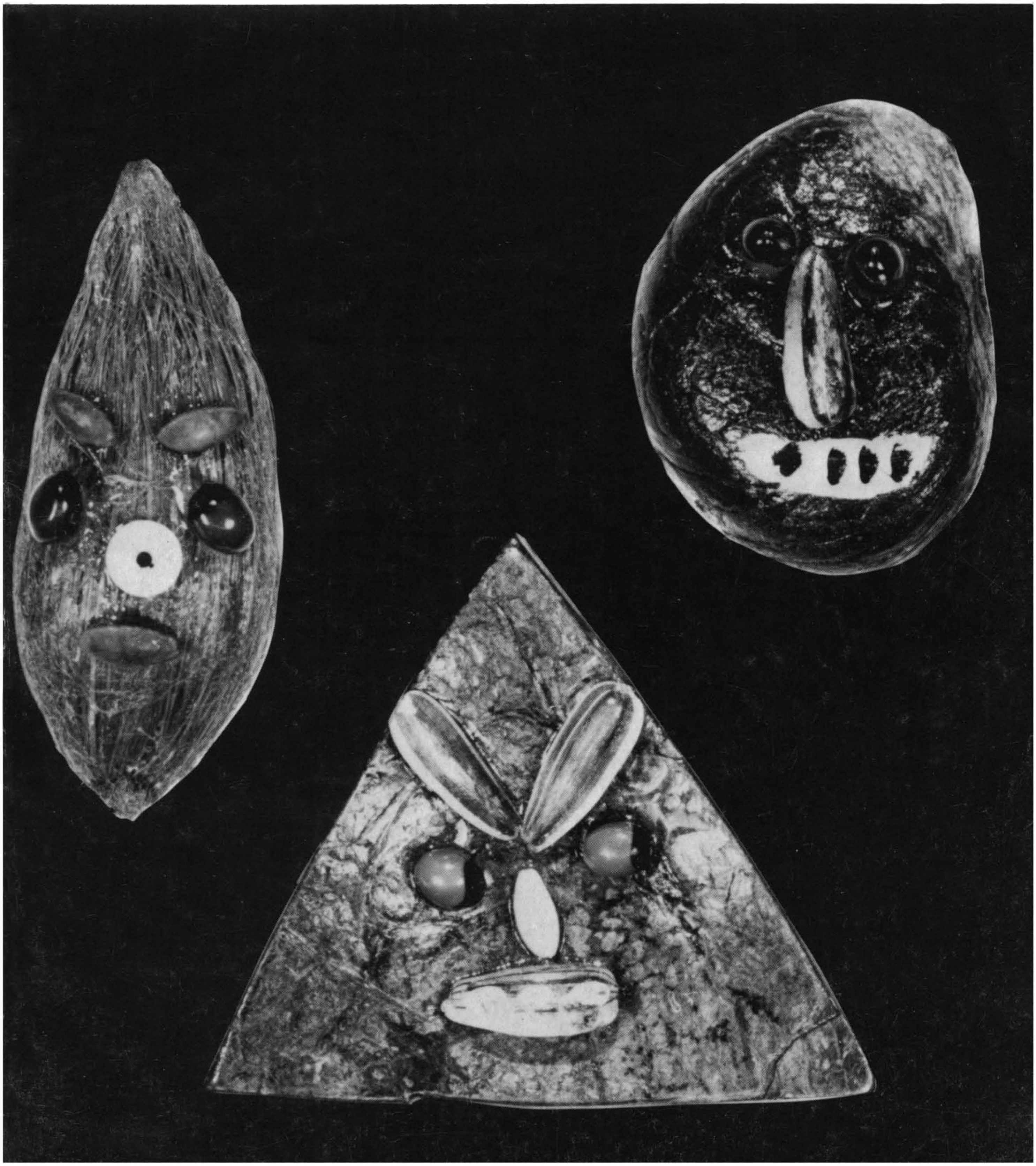
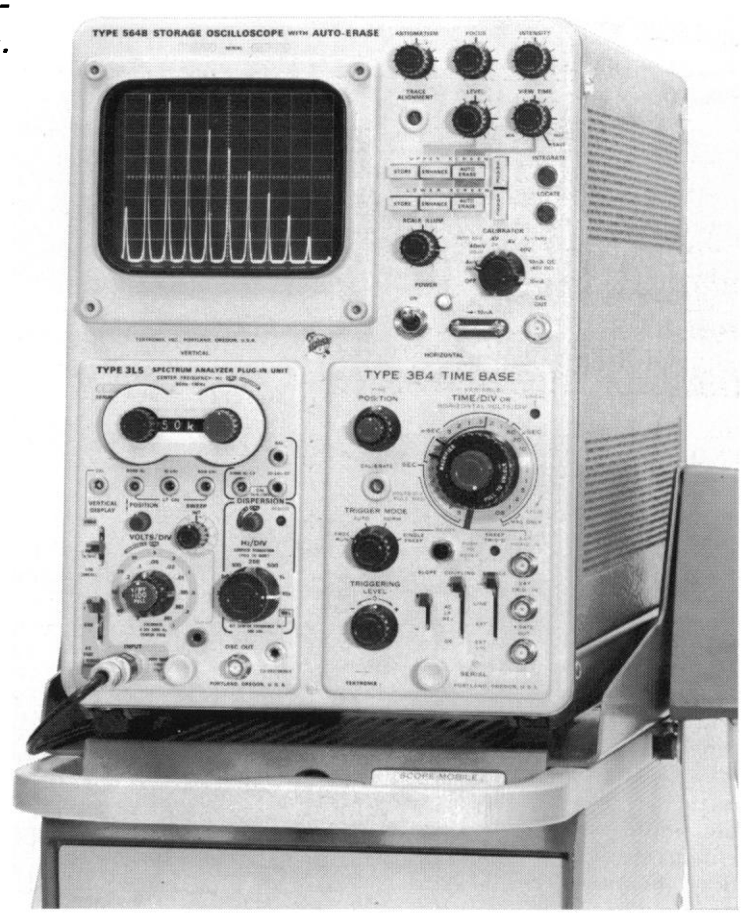
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Now you can widen your thinking about measurements which could best be made on a frequency basis. Add the Type 3L5 to the Tektronix '560' oscilloscope system for a low-frequency (10 Hz to 1 MHz) spectrum analyzer that is convenient to use and accurate. Calibrated functions, such as vertical deflection factor, center frequency, and dispersion, afford the same confidence for frequency-domain measurements as now exist in the time domain.

Calibrated FREQUENCY-DOMAIN Measurements

Ask your Tektronix field engineer to demonstrate the Type 3L5 Spectrum Analyzer and acquaint you with the range of performance options in the '560' series. Mainframe choices are single beam with conventional or storage displays, or dual beam. Plug-ins cover many application areas: multi-trace, differential, state-of-the-art sampling and spectrum analysis.



TYPE 3L5 SPECIFICATIONS

Center Frequency Range — 50 Hz to 990 kHz, accurate within 5% plus an increment depending on range and temperature.

Deflection Factor — 10 μV/div to 2 V/div in calibrated RMS volts/div, accurate within 3% to 1 mV/div, within 6% to 10 μV/div.

Calibrated Dispersion — 10 Hz/div to 100 kHz/div (1 MHz full screen) in 9 steps (1-2-5 sequence), accurate within 10%; linearity is within 3%.

Resolution Bandwidth — $\leq$10 Hz to $\geq$500 Hz, cross-coupled with dispersion control but separately switchable.

Display Flatness — within 0.5 dB at most deflection factors.

On-Screen Dynamic Range — $\geq$60 dB in the LOG (uncalibrated) mode.

Video Mode — easy conversion to calibrated time-based displays. Bandwidth is 10 Hz to 1 MHz, basic deflection factor is 1 mV/div.

Type 3L5 Spectrum Analyzer $1,125

For information, circle the Reader Service Number, or write Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005

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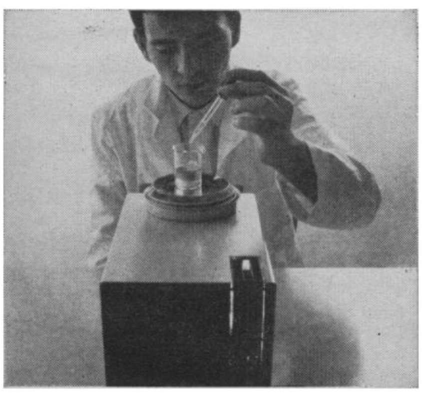
WEIGHT WATCHERS:

These Mettler balances can help reduce your weighing problems

If you have weight problems, chances are they can be solved with one of these three Mettler balances. Two are top-loaders, one an analytical. Collectively, they solve virtually any weighing problem in the laboratory. Individually, they perform their special jobs with unique speed, ease and precision.

Weight Watching Has Never Been Easier

The Mettler P1200, a well established and versatile top-loading balance, now has digital readout. This feature permits even relatively unskilled operators to obtain accurate results without misinterpretation or reading errors.



The P1200 will tackle weighings to 1200 grams (plus 100-gram tare), and give you a precision of ±5 mg. That's better than one part in 250,000. But despite its capabilities for handling the bigger weighing jobs, the P1200 will also complete a weighing in just three seconds. It will also checkweigh to plus or minus values as fast as you can place an object on the scale, and without referring to scale readout. Powdery, granular or liquid substances can be filled rapidly by the use of a filling guide which shows the approximate weight on the pan throughout the entire weighing operation. This eliminates time-consuming interruptions for reading the balance.

Remove Grams — Positively

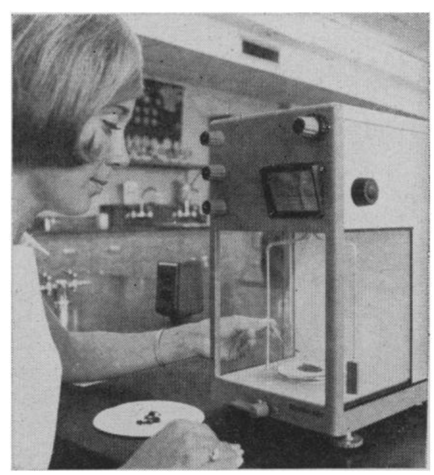
The P160, another top-loader, weighs unknowns to 160 grams with a precision of ±1 mg. In addition to having all the features of the P1200, it is ideally suited for weight loss studies. It has a reverse scale which gives a positive reading as weight decreases in drying, evaporation and residue determination studies. This feature eliminates time-consuming calculations and the possibility of arithmetical errors. It also simplifies gravimetric titrations (for more information on the advantages of gravimetric titrimetry, write for Bulletin M-1014A).

A Well-Balanced Balance

Slight changes in the balance level of the P1200 and the P160 (as in all Mettler top-loaders) are automatically compensated for by a zero point restoration feature. We call it Mettler Levelmatic. If your balance is out of plumb beyond its compensation range, you won't be able to make a weight reading because the readout is automatically obscured. Because Levelmatic automatically compensates for most shifts in zero position, it is rarely necessary to re-zero the balance before weighing.

Have Your Cake and Eat It

If you need an analytical balance to watch your weight, consider the Mettler H20 . . . it's really two balances in one. It gives you the 160.1-gram capacity of a macro-analytical balance, and the ±0.01 mg precision of a semimicro instrument. The H20 readout, like the P1200 and P160, is digital. It also has a high-speed filling guide, and an optional accessory will let you weigh objects below the balance; for example, to make specific gravity measurements by weighing objects submerged in liquids. Because of the unrestricted optical taring feature of the H20, you can tare off the weight of your container in seconds, and begin weighing-in with readout at zero. You can't make a weighing mistake. If you're adding several components, you can dial back to zero for each one.



Some Food For Thought

In case you have a weighing requirement that can't be solved by one of these three balances, Mettler has 35 more models ranging from top-loaders that weigh to 13 kilos all the way through analyticals to ultra micro instruments with precision of ±0.1 μg. We'll bet a gram-cracker that one of these will fill the bill. To arrange for a free demonstration or trial, or for further particulars, write to Mettler Instrument Corporation, 20 Nassau Street, Princeton, New Jersey 08540.

Mettler®

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COVER

Jequirity beans (*Abrus precatorius*) used as "eyes" in costume jewelry. These beans, ovoid in shape and measuring 1/4 to 1/2 inch in length, contain at least one deadly poison, the phytotoxin abrin. Death from ingestion of the seeds when chewed and swallowed has been recorded. See page 245. [Charles R. Gunn, U.S. Department of Agriculture]

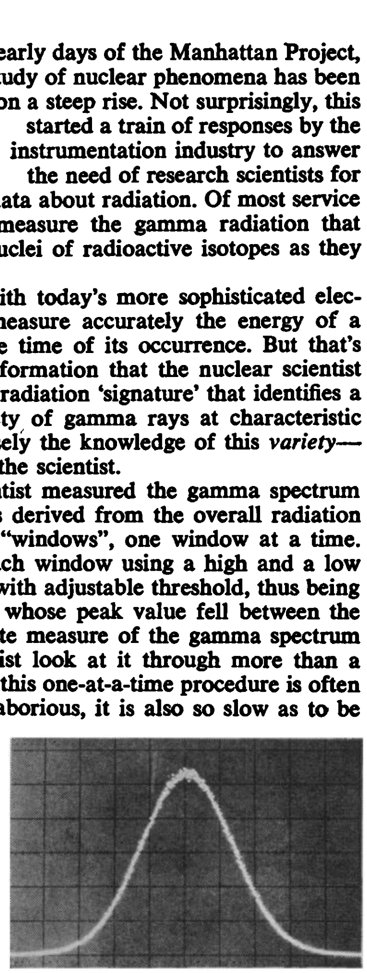
Tame complex scientific data... produce useful information directly

How to See Through 1000 Windows at a Time

Since the early days of the Manhattan Project, the study of nuclear phenomena has been on a steep rise. Not surprisingly, this started a train of responses by the instrumentation industry to answer the need of research scientists for analytical data about radiation. Of most service have been instruments to measure the gamma radiation that originates in the unstable nuclei of radioactive isotopes as they decay to stable states.

It's not really difficult, with today's more sophisticated electronic instrumentation to measure accurately the energy of a discrete gamma ray and the time of its occurrence. But that's only a small part of the information that the nuclear scientist needs to know. Usually the radiation 'signature' that identifies a material consists of a variety of gamma rays at characteristic energy levels, and it's precisely the knowledge of this *variety*—or spectrum—that interests the scientist.

Initially the nuclear scientist measured the gamma spectrum by looking at voltage pulses derived from the overall radiation through a series of energy "windows", one window at a time. He built the "frame" for each window using a high and a low voltage discriminator, each with adjustable threshold, thus being able to look only at pulses whose peak value fell between the two levels. Since an adequate measure of the gamma spectrum may require that the scientist look at it through more than a thousand different windows, this one-at-a-time procedure is often inadequate. Not only is it laborious, it is also so slow as to be useless where the decay rate (half-life) is very short.



Probability density display of Gaussian noise

Enter the multichannel analyzer (MCA), newest of which is the H-P 5400A. The MCA looks at gamma radiation through as many as 1024 windows, *simultaneously* sorting the pulses into as many amplitude groups. It counts and totalizes the pulses in each group and stores the results in memory for live or static display on the built-in cathode ray tube, for readout on a paper record or for input to a computer.

Speed, the essential characteristic of an MCA, reaches its peak in the 5400A. Employing a new analog-to-digital converter with a clock rate of 100 MHz, the 5400A sorts and digitizes input signals into one of 1024 categories in no more than 13 microseconds.

In its present state of refinement, the 5400A MCA has not only met the nuclear scientist's need for a gamma spectrum analyzer, but has also attracted the attention of analytical scientists in other disciplines. Biochemists for example have used it as a multichannel scaler to accumulate time/rate curves of activity for uptake/clearance studies in nuclear medicine. Design engineers have performed probability density analysis of continuous input signals with the 5400A to isolate signal and noise characteristics. Other solutions of complex measurement problems are described in the March 1968 issue of the *Hewlett-Packard Journal*, yours on request.

Designing for the Electronics-Shy Analyst

Natural strangers to the complex world of electronics, chemists and other analysts have long since been trapped in it because of their seemingly insatiable appetite for analytical instruments that are essentially electronic creations. Both readily admit the impossibility of doing their analytical work at today's speed and accuracy standards without electronics. But upon introspection they also acknowledge a deep yearning somehow to exclude the whole complicated world of transistors, diodes and integrated circuits from their laboratories.

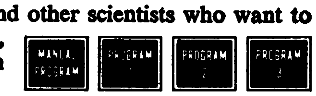
Yet exactly the reverse is happening: as the scientist uses more and more instruments in his quest for analytical speed, he produces greater and greater quantities of analog chart recordings, each of which he must laboriously interpret if he is to decode its analytical message. Bogged down in this task, the analyst once again has had to turn to the electronic designer . . . this time for a device which automatically interprets the *analog* output of such analytical instruments as the ubiquitous gas chromatograph, and translates it into *digital* data, the stuff of which quantitative analysis is made.

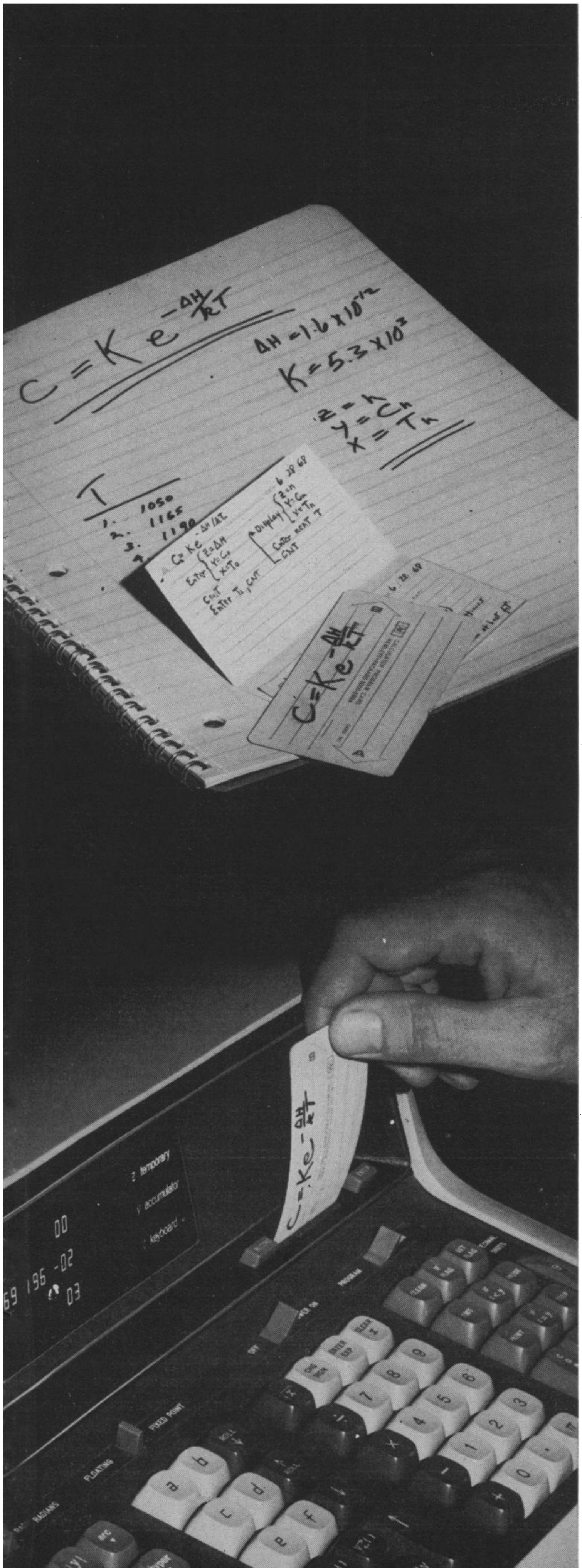
The device which does this job best—the digital integrator—employs even more complex electronic circuits than does the gas chromatograph. And it requires frequent adjustments of a dozen or more programming controls, each somewhat mysterious to the electronics-shy analyst.

For many, this is the last straw. Consequently they have refused to admit into their laboratories the one electronic device that, ironically, can do more than any other to speed their analyses and simplify their routine.

Aware of this problem in human engineering, a team of H-P chemists and electronic engineers together have recently completed the design of an integrator that can be programmed for an almost unlimited variety of analytical conditions just by pushing buttons. No longer must the recalcitrant analyst make the difficult choice of plunging into the strange world of integrator programming, or living in a world bereft of the benefits of digital integrators. The H-P 3370A lets him have the best of both worlds.

For electronics-shy chemists and other scientists who want to know how this was accomplished, we offer a new Bulletin 3370A, on request.





Restoring the Balance Between Analysis and Computation

Time was when the scientist enjoyed sitting at his desk to manipulate the raw analytical data that he had accumulated while standing at the bench. Somehow complex computations with classical formulae created a pleasant interlude between creative sessions at the bench.

During the post-war period, this somewhat romantic attitude has gradually disappeared. Backed by a seemingly endless parade of new automatic instruments for analysis, the scientist has become such a prodigious producer of analytical data that the balance between his analytical and computational loads has been destroyed. One of the top technical management problems of the day is to release the scientist from the time-consuming drudgery of massive computations and return him to creative work.

Obvious solutions are not always satisfactory. The typical electronic desk calculator is simply not up to the job: many of the commonest mathematical routines of science and engineering are beyond its scope. On the other hand, the computer is often too imposing for the problem immediately at hand, too inconvenient of access or too expensive to justify, and always relatively difficult to program and use.

What is needed is a machine that combines the accessibility of the calculator and the capacity and speed of the computer. Such is the H-P 9100A computing calculator. It not only resembles but even surpasses the computer in its ability to handle very large (10^{99}) and very small (10^{-98}) numbers at the same time. In practical terms, for example, the 9100A allows the scientist to use Avogadro's number (6×10^{23}) and Planck's constant (6.6×10^{-27}) in the same computation without risk of overflowing its capacity, and without requiring the scientist to keep orders of magnitude in his head.

The 9100A also shares with the large computer the ability to solve complicated computations in fractions of a second. This stems from its ability to store as many as 196 program instructions, some of which may be decisions based on conditional branching and looping commands. But the 9100A is far easier to use than any computer because of two unique characteristics which bring it within easy reach even of the scientist who has no knowledge of computer programming techniques. First, all programming is carried out in English or common math symbols, not in special computer language. Second, even the most complex program can be stored on wallet-size magnetic cards and entered into the 9100A simply by inserting the card in a slot (as in the photo at left) and pushing a button.

As a result the 9100A can, for example, determine the straight line that best fits a set of experimentally obtained X-Y points in seconds. The scientist need only insert the appropriate program card and enter the data points on the keyboard. The 9100A then carries out the entire 'least squares fit' computation and displays the slope (m), intercept (b), and correlation coefficient (r). It will even plot the line itself when equipped with the forthcoming H-P X-Y plotter.

Yet the 9100A is no bigger and costs no more than a calculator. More important, it is as easy to use since all machine operations are in English or common math symbols. This includes single-key operation for log, exponential, trig and hyperbolic functions, and for coordinate conversions from polar to rectangular and vice-versa.

If you want to know how the 9100A can restore the balance between analysis and computation in your lab, get a copy of our new 22-page brochure. Write Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

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ANALYTICAL INSTRUMENTS

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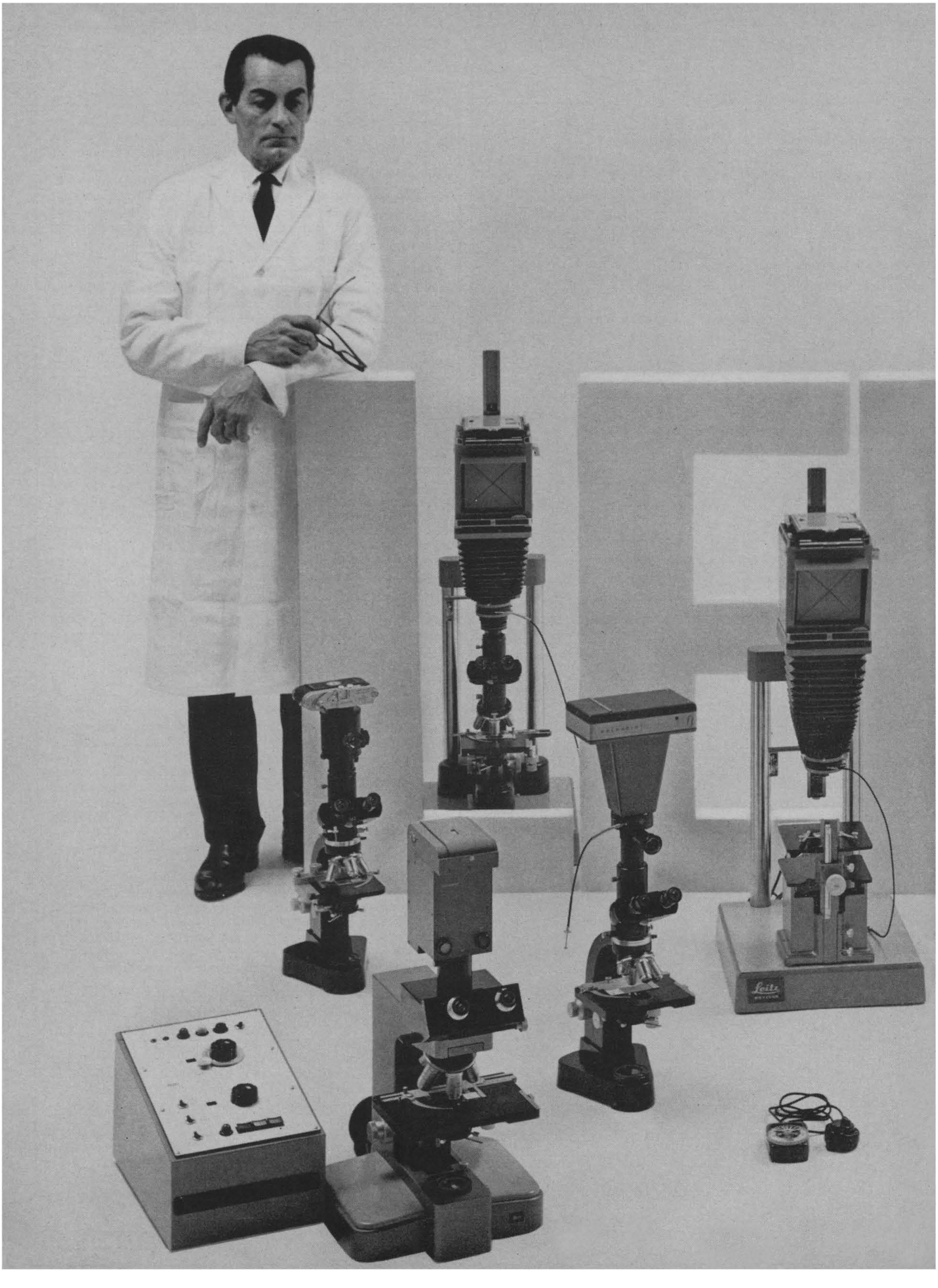
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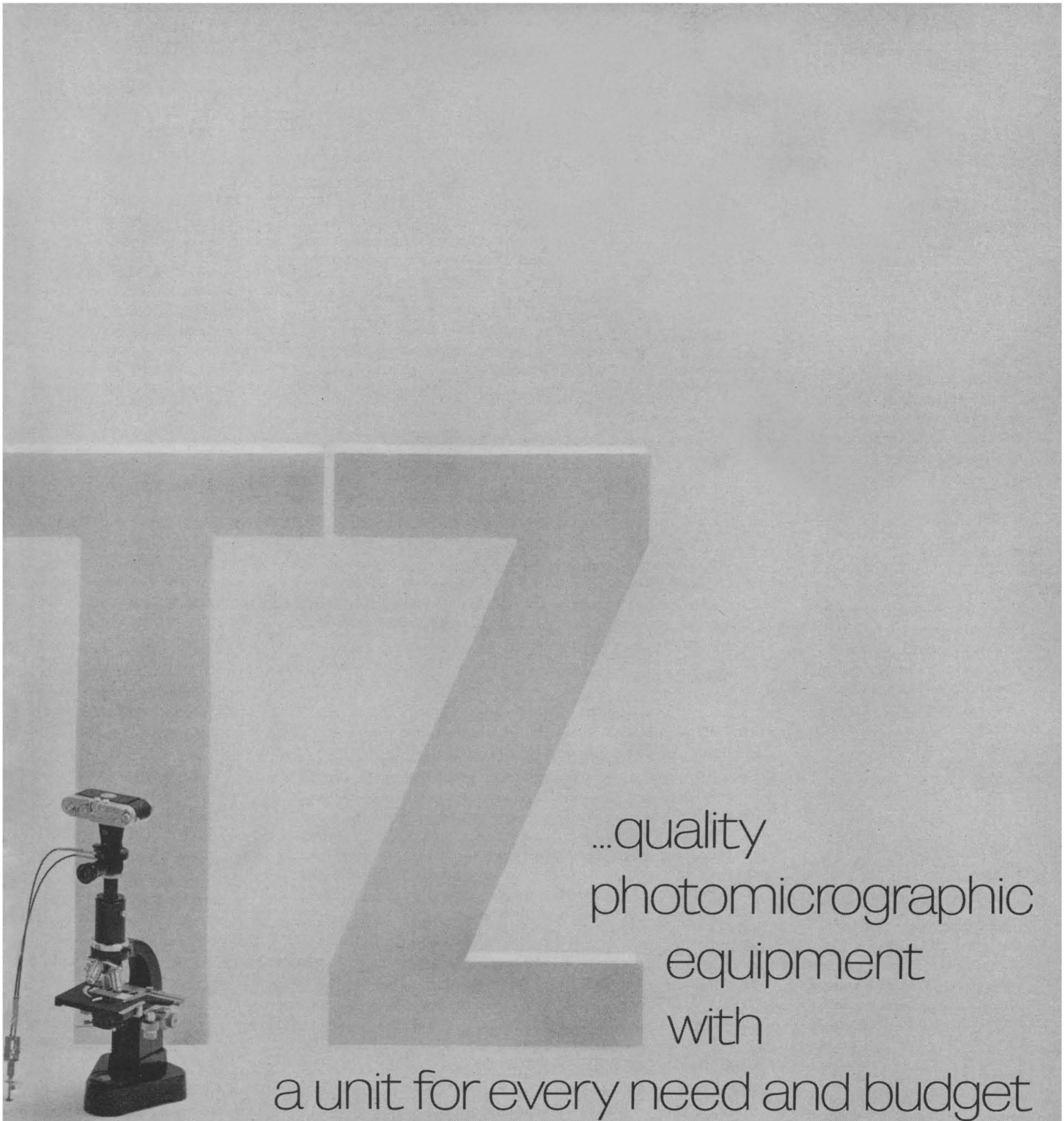

Meet the most versatile and talented of performers with one common denominator—Leitz quality. Whether your need is an occasional photomicrograph to illustrate a lecture, routine recording, or a specialized apparatus for a research project, Leitz can provide the widest possible range of instruments and illuminators.

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Florida. The seeds are ovoid, ¼ to ½ inch long, combining bright glossy vermilion with jet black. In old seeds the vermilion area may be dark red, reddish-orange, reddish-brown, or reddish-yellow. The black portion, restricted to the hilum end of the seed, occupies about one-third of the seed coat. The black area is not altered with age.

These seeds contain at least one deadly poison, the phytotoxin abrin, an albumin. Other physiologically active substances are also present. Deaths from ingestion of the seeds, when chewed and swallowed by humans and when fed without their seed coats to animals, have been recorded. Extracts from the seeds, given subcutaneously, are approximately 100 times more toxic than swallowed seeds (*2*).

I have conducted preliminary tests which indicate that germinating *Abrus precatorius* seeds have an adverse effect on germinating ryegrass seed (*Lolium multiflorum* Lam. and *L. perenne* L.). The Hazardous Substances Branch of the Food and Drug Administration also plans to conduct tests on the toxicity of *A. precatorius* seeds.

CHARLES R. GUNN
Crops Research Division, U.S. Department of Agriculture, Beltsville, Maryland 20705

References

1. C. R. Gunn, *Gard. J.* **19**, 2 (1969).
2. J. M. Kingsbury, *Poisonous Plants of the United States and Canada* (Prentice-Hall, Englewood Cliffs, N.J., 1964).

Einar Lundsgaard

Word has come from Copenhagen of the death, during the last days of 1968, of Einar Lundsgaard. In these times of rush and short recall, I am particularly keen to refresh the memory of the scientific community about his truly great discovery which is now slipping into the background. Personally and scientifically, I encountered Lundsgaard during my period of maturation and I owe him much. I was in Meyerhof's laboratory in Heidelberg when he came in 1930: tall, blond, and very Danish, with his handsome wife, Helle. There we first met and became friends, and later when I moved to Copenhagen in 1932 and stayed until 1939, we saw each other a great deal. In the fall of 1967, his friends and colleagues went to Copenhagen to celebrate the 40th anniversary of the discovery of what he called the a-lactacid contraction of iodoacetate-poisoned muscle. When this startling news reached us in Meyerhof's laboratory, it was very upsetting to our group which looked upon glycolytic lactic acid as the link between metabolic energy generation and muscle contraction.

The interest in iodonated organic compounds which might have metabolic actions similar to thyroxin induced Lundsgaard to study iodonated acetic acid. Its injection into animals, however, yielded a rather unexpected effect: for a few minutes the animal behaved quite normally, but suddenly it turned over and its muscles became rigid. Such rigor was dependent on prior muscle activity since denervated or curarized muscles did not respond. But when rigor developed, the expected burst of lactic acid was missing. Lundsgaard elegantly solved the puzzle. He showed that: (i) iodoacetate inhibited glycolysis; and (ii) that poisoned muscle performed a limited number of normal contractions at the expense of dephosphorylation of creatine phosphate, then newly found in muscle and in need of a function. The rigor mortis-like condition developed when the limited supply of creatine phosphate was exhausted.

Lundsgaard had discovered that the muscle machine can be driven by phosphate bond energy, and he shrewdly realized that this type of energy was "nearer," as he expressed it, to the conversion of metabolic energy into mechanical energy than lactic acid. He was right, because it soon developed that the glycolytic reaction is a feeder of phosphate bond energy and not of acid. On the way, Lundsgaard also provided an enormously useful tool for studying enzyme mechanisms. Iodoacetate has become one of the standard reagents for SH-blocking in enzymes. Thus, iodoacetate inhibits glycolysis because it blocks the functional SH in phosphoglyceraldehyde dehydrogenase.

In the middle 30's, Lundsgaard became professor of physiology at Copenhagen University and trained many biochemists and physicians. Herman Kalckar was one of his graduate students. And, even though I did not formally work with Lundsgaard, I consider myself his pupil. My subsequent work was profoundly influenced by his discoveries which changed our concepts of metabolic energy transformation.

FRITZ LIPMANN

Rockefeller University,
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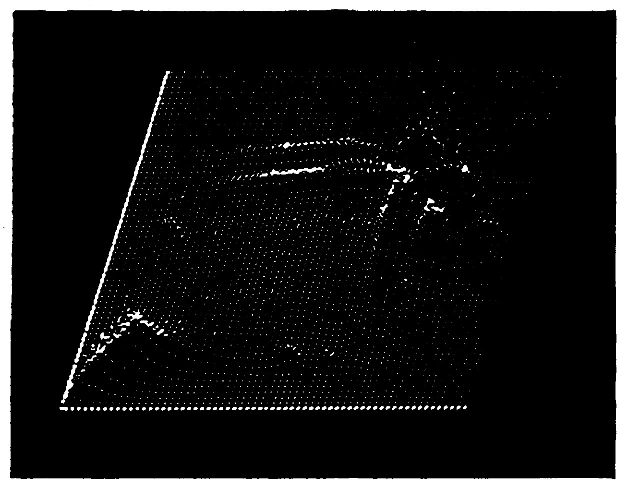
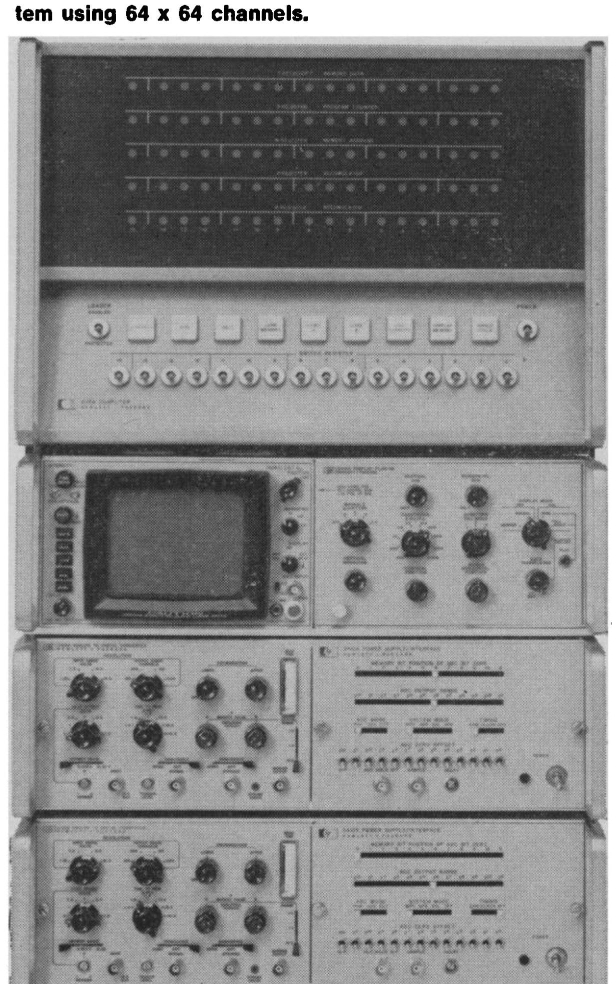
You can reconfigure this multiparameter analyzer in 10 minutes.



This isometric display of Co^{60} coincidence spectra was generated by an HP 5406A Multiparameter Analyzer System using 64 x 64 channels.



Hewlett-Packard's new multiparameter analyzer systems use HP computers to simplify control and give extra flexibility to your analysis.

A specially written software package lets you configure—and later reconfigure—the system to suit each experiment. In 10 minutes, via the teletype, you can optimize core storage for count capacity vs. number of channels. For one experiment, you may want maximum counts/channel for statistical validity. For another, you'll want maximum number of channels for utmost resolution. Want both? You can add core storage easily, up to 8K in the mainframe. With HP's special subroutines there's no need to write any program to get on the air. But, if you like, you can add your own subroutines in FORTRAN, ALGOL, or assembly language.

Added to this operating convenience is the complete modular flexibility of both computer and analyzer. You buy only as much of a system as you need to start with. Later, you can add larger core memory, more analog-to-digital converters, scalers or peripheral devices such as magnetic tape and disc storage.

The minimum system, the HP 5405A Single Parameter Analyzer System, contains a single display, one ADC, the HP 2115A Computer with 4K memory and a teletypewriter. It operates in pulse-height analysis and sampled voltage modes.

The HP 5406A Multiparameter Analyzer System can have two ADCs, optionally expandable up to 16 with a multiplex control. With two ADCs, it operates in the coincidence mode with resolution in the microsecond range. External coincidence equipment can be added to give nanosecond resolution. Software sub-routines generate three display modes: isometric shown here, contour and X-Y slice.

No other nuclear analyzer offers such flexibility and ease of operation. No other system combines the advantage of both an HP instrumentation computer and an HP multichannel analyzer—with software written for the nuclear physicist. Price of the 5406A Multiparameter Analyzer System with two ADCs, under $37,000.

Call your local HP field engineer for a complete description of both systems and accessories. Or write Jim Sheldon, Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

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NUCLEAR INSTRUMENTS

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SCIENCE

Which Goals To Emphasize

How many dollars and how many men would be required to achieve by 1975 all we would like to achieve in urban renewal, better housing, space exploration, health, education, and other national goals?

Several years ago Leonard Lecht* of the National Planning Association analyzed the cost of achieving 16 such national goals by 1975. He concluded that the cost would be $150 billion more than the gross national product of 1 trillion dollars he expected for 1975. Charles Schultz,† working with more recent data, expects the GNP to reach the trillion-dollar level by 1971 and to be substantially higher in 1975. He also expects substantial surpluses in the federal budget by that time unless taxes are cut. We may not be able to do all we would like in the next half-dozen years, but there will be money enough to do much.

Lecht‡ has now calculated the number of workers needed to achieve all 16 national goals. Again his conclusion is that there will not be enough. A labor force of 101 million would be required, 10 million more than can be expected in 1975.

If these projections are reasonably accurate, we can devote large sums to urban renewal, pollution abatement, improved education, better health, space, defense, and other goals, but there will not be enough workers to do everything desirable. In establishing the priorities that will therefore be necessary, there will be two criteria. The intrinsic merits of the various alternatives will of course be considered, but account should also be taken of the kinds of additional jobs each alternative would create and of the segments of the population that would benefit most directly from their creation, for jobs are themselves a goal as well as a means of achieving other goals.

To spend an additional billion dollars a year on housing or to spend that sum on education and health would, in either case, call for an increase in the labor force of about 100,000 workers. But the mix would be very different in the two cases. The housing effort would require 61,000 craftsmen, operatives, and laborers per billion dollars; the health and education goals would require only 16,000 workers in these categories. In contrast, the health and education goals would require 46,000 teachers, doctors, dentists, and other professionals per billion dollars, while the housing effort would call for only 8,000 professionals.

It is no surprise to be told that the mixture of skills necessary to do one job is quite different from that required to do a different job. But the quantification and detail Lecht has provided allow greater precision in projecting the kinds of new jobs each alternative would create. Decisions as to which programs and goals to pursue most vigorously at any particular time are thus given added strength as instruments of social policy.

Unemployment—it is widely known—is highest among young workers and in minority groups. Programs that would most quickly create many new jobs for members of these groups include housing, urban renewal, better transportation, and the improvement of water supplies and other natural resources. Judgments would surely differ among policy makers as to whether these are the goals of highest individual merit, but they are important in their own right and they all have a plus factor in their labor-market implications. Other goals cannot be forgotten, but these are ones to emphasize in the next few years.—DAEL WOLFLE

* L. A. Lecht, *Goals, Priorities, and Dollars* (Free Press, New York, 1966). † C. L. Schultz, "Budget alternatives after Vietnam," in *Agenda for the Nation*, K. Gordon, Ed. (Brookings Institution, Washington, D.C., 1969). ‡ L. A. Lecht, *Manpower Needs for National Goals in the 1970's* (Praeger, New York, 1969).