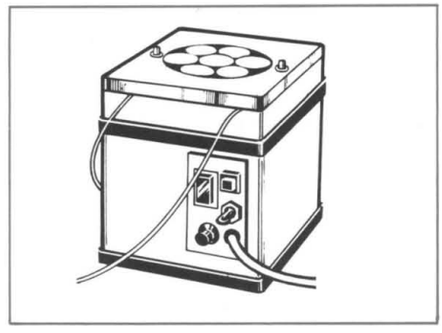
SCIENCE

30 May 1969
Vol. 164, No. 3883

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

This compact pump is only 125×125×155 mm (5×5×6 in).
It can handle corrosive, sterile and dangerous materials
with complete safety.



LKB IN THE SERVICE OF SCIENCE

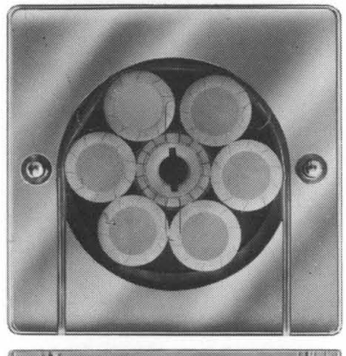
LKB INSTRUMENTS INC.● 12221 PARKLAWN DRIVE ● ROCKVILLE Md. 20852
SALES AND SERVICE THROUGHOUT THE WORLD: STOCKHOLM, THE HAGUE, COPENHAGEN, ROME, VIENNA, LONDON

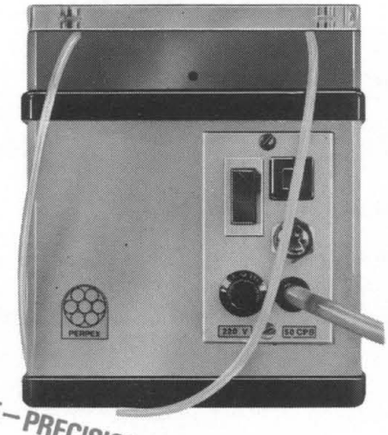
P P P's with lo P

Perpex **P**eristaltic **P**umps with low **P**ulsation.

The VarioPerpex has continuously variable flow rates within the wide range 1.6 to 200 ml per hour, for a standard gear box, and lower flow rates are possible by using other easily exchangeable gear boxes.
Fluctuations, due to mains voltage variations, have been reduced to a minimum by the employment of a stepmotor.
The Vario Perpex has all the design advantages of the Perpex Pump.

The Perpex and VarioPerpex pumps, which form the new LKB pump range, have been specially designed for chromatographic, electrophoretic and all other analytical operations requiring a steady flow over long periods.
Compact and lightweight, well capable of meeting the vigorous requirements of research and industrial laboratories.
Accurate flow rate and minimal tube wear due to the patented, machined, plastic roller system.





The Perpex Pump provides continuous, precise delivery of a great variety of liquids and gases without pulsation even at the lowest speeds.
Takes up little space on the bench, can be conveniently stacked to provide multiple channels, and the absence of bearings in the pumping area eliminates vibration, and contamination from grease.
Six standard gears are available and a choice of drive ensures accurate, repeatable pumping speeds.

PLUS ONE P MORE – PRECISION!

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SCIENCE

SCIENCE is published weekly on Friday and on the fourth Tuesday in September by the American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005. Now combined with **The Scientific Monthly®**. Second-class postage paid at Washington, D.C. Annual subscriptions $12; foreign postage: Americas $3; overseas $5; single copies, 50¢ (back issues, $1) except **Guide to Scientific Instruments**, which is $2. School year subscriptions: 9 months, $9; 10 months, $10. Provide 4 weeks notice for change of address, giving new and old address and zip codes. Send a recent address label. SCIENCE is indexed in the **Reader's Guide to Periodical Literature.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Tar bubbles at Rancho La Brea tar pits, Los Angeles, California. Within such tar pits are found petroleum-impregnated bone which can be dated by the radiocarbon technique, thus revealing ages of animals inhabiting the area thousands of years ago. See page 1051. [J. R. MacDonald, Los Angeles County Museum]

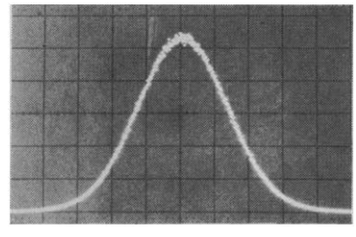
Tame complex scientific data... produce useful information directly

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.

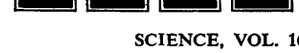
Yet exactly the reverse is happening: as the scientist uses more and more instruments in his quest for analytical speed, he produces greater and greater quantities of analog chart recordings, each of which he must laboriously interpret if he is to decode its analytical message. Bogged down in this task, 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.

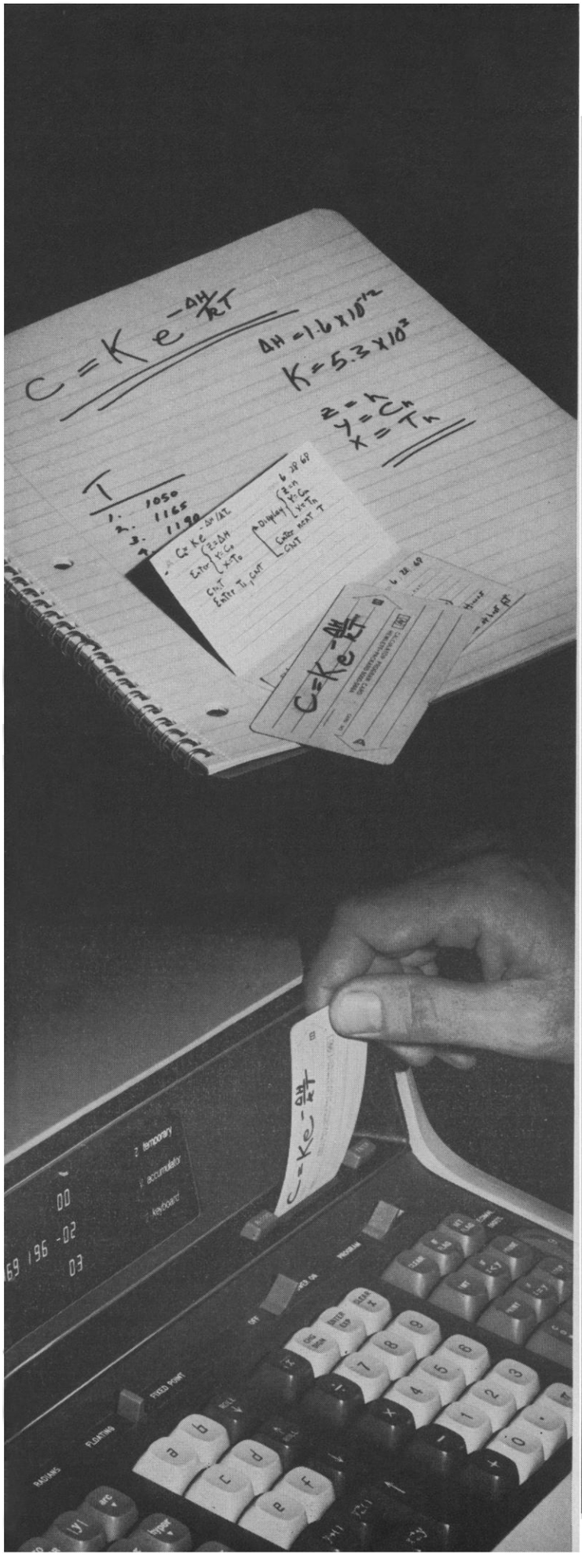
The device which does this job best—the digital integrator—employs even more complex electronic circuits than does the gas chromatograph. And it requires frequent adjustments of a dozen or more programming controls, each somewhat mysterious to the electronics-shy analyst.

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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Think of any electrochemical experiment... Chances are the PAR Model 170 can perform it.

Our new Model 170 Electrochemistry System thrives on variety. It offers — for the first time in a single instrument — all the circuitry and control functions necessary to perform virtually every commonly-used electrochemical technique.

For example, it allows you to perform chronopotentiometry or chronoamperometry without requiring any auxiliary equipment. It also contains built-in controls for current reversal at a potential threshold. What's more, the 170's 100 volts of potentiostat compliance, and its 1 amp capability at this voltage (or 5 amps at 20 volts) mean that you can work in the most exotic solvent systems.

The 170 can also perform:

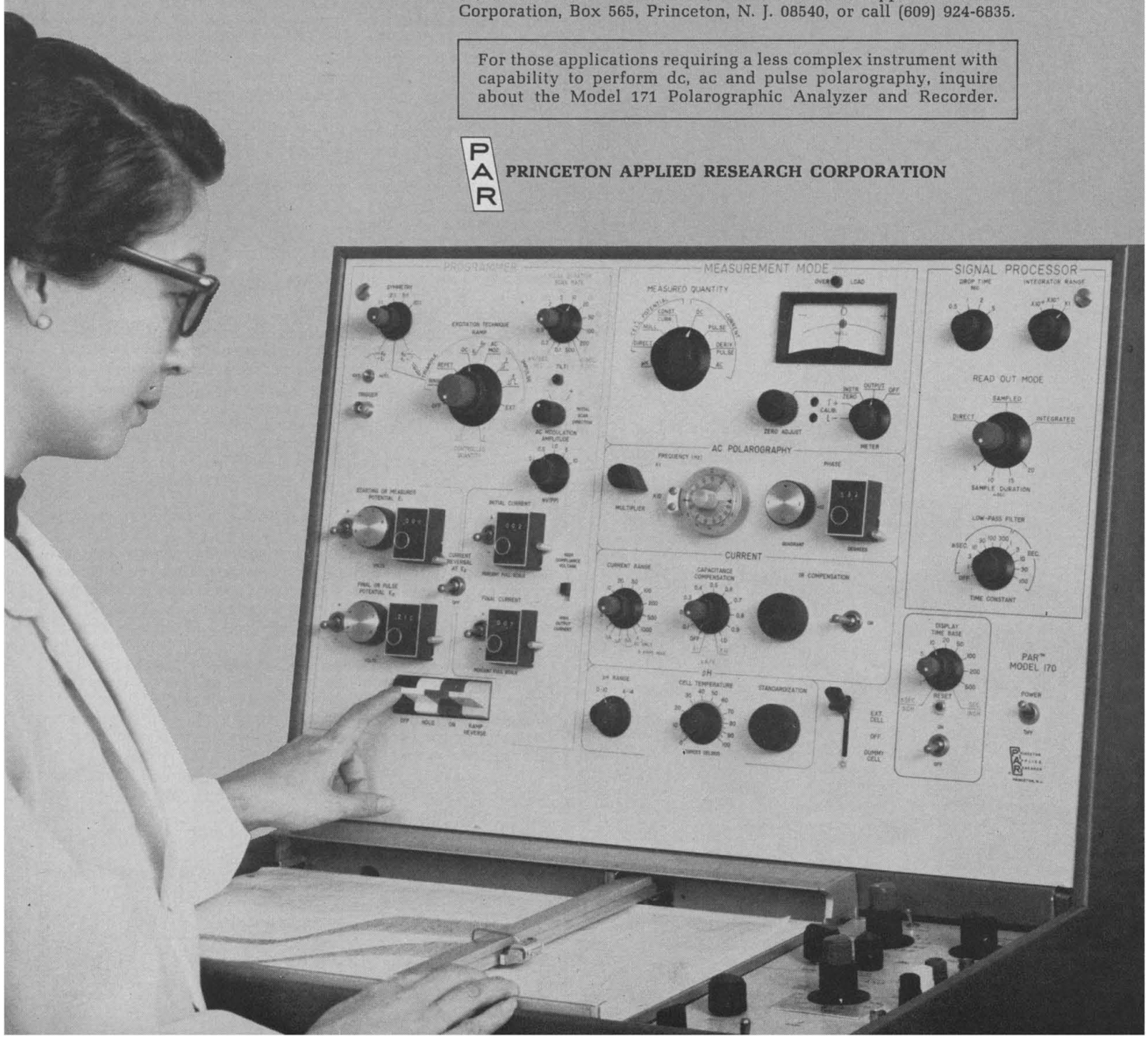
- phase-sensitive ac polarography
- pulse polarography
- dc polarography
- anodic stripping analysis
- cyclic voltammetry
- pH and specific ion measurement
- direct potentiometry
- controlled-potential electrolysis
- controlled-current electrolysis
- chronopotentiometry
- chronoamperometry
- pulse response studies

The Model 170 contains a built-in X-Y plotter for accurate current-voltage curve recording as well as a highly stable coulometric integrator and an accurate time-base generator. The only external equipment occasionally required is an oscilloscope.

The price? With mechanical drop timer and built-in X-Y recorder, $9,500. For more information, write Princeton Applied Research Corporation, Box 565, Princeton, N. J. 08540, or call (609) 924-6835.

For those applications requiring a less complex instrument with capability to perform dc, ac and pulse polarography, inquire about the Model 171 Polarographic Analyzer and Recorder.

PAR **PRINCETON APPLIED RESEARCH CORPORATION**



Kodak

In hope of doing each other some good

Sophistication in solvents

3-Aminophthalimide (EASTMAN 10705), 4-Dimethylamino-4'-nitrostilbene (EASTMAN 10702), and N,N-Dimethyl-m-nitroaniline (EASTMAN 1208), fluorescent compounds, are offered for a relatively inexpensive method of calibrating a spectrofluorometer, described in *Anal. Chem. 36*:368 (1964).

Since the analytical laboratory turns to Eastman for the less common chemical items that its forward-looking instrumentation requires, Eastman is also the right label for the more common ones, like spectro-grade solvents. **Why, really?**

Convenience in ordering isn't the only reason.

Eastman, as you may have heard, produces solvents not only for our own laboratories but for uses far beyond the laboratory. This provides inside information on what can get into them that ought to come out before offering them to *any* laboratory for spectrophotometric use. Internal complaints are likely to be heard and acted upon before customers have reason to complain.

- So the useful IR windows tend to open wider, and the UV cutoffs creep lower, and we usually don't bother to mention it. Of course, all EASTMAN Spectro Grade Solvents must pass our published UV and IR specs. Not just the one. Not just the other. Both.
- Water in the Acetonitrile (EASTMAN S488) keeps going down year to year.
- A small percentage of the molecules in a bottle of Bromoform (EASTMAN S45) had a chlorine atom on them. We now know why and how to keep that percentage much lower.
- Methyl Formate (EASTMAN S1227) no longer has a discernible OH band.

This story could go on and on. And it does.

"EASTMAN Spectro Solvents" (Brochure JJ-3) charts all we formally claim about all the ones we offer—all the familiar ones, plus Bromotrichloromethane (EASTMAN S5995), Decahydronaphthalene (EASTMAN S1905), Dodecane (EASTMAN S2556), 2-Methoxyethanol (EASTMAN S2381), and Trifluoroethanol (EASTMAN S8890). Request free copy from Eastman Kodak Company, Eastman Organic Chemicals, Rochester, N.Y. 14650.

On American soil

At a forum entitled "New Horizons in Color Aerial Photography" under the auspices of the American Society of Photogrammetry and the Society of Photographic Scientists and Engineers at New York's Coliseum on Monday morning, June 9, a man from the Kodak Research Laboratories explains why he has been assembling samples of as many different categories of American soil and sand as a concerted effort can collect, and to what purpose the light reflectance of all these samples has been measured—wet and dry—over a broad spectral range.

If you see why you should attend but are reading this too late to do so, contact can be established through Aerial Product Planning, Eastman Kodak Company, Rochester, N.Y. 14650.

By an electron micrographer for electron micrographers

A new, stiffer, standard-plate-size, low-volatile-content ESTAR Base film for electron microscopes is designed for handling under the cheerful yellow KODAK Safelight Filter OA. It is *different* sensitometrically from the familiar KODAK Electron Image Plate. The emulsion was selected for electron micrography by the senior electron micrographer of the Kodak Research Laboratories, who, truth to tell, also conducts more fundamental scientific investigations. Fellow electron micrographers elsewhere who have been kind enough to evaluate the new film like it very much.

Those who feel the need for a change from presently used EM media should get in touch with one W. A. Sykes, Mail Code 926, Eastman Kodak Company, Rochester, N.Y. 14650.

What do you want to do with your money?

We keep trying to sell things. Perhaps, as hinted above, color film *could* make a soil scientist's working days more productive. Perhaps spectrofluorometers and electron microscopes *had* better be supplied with reliable reagents and film. How much are these things worth?

Through the city where the things are made, a river flows into a large lake. Far fewer species of animals and plants probably inhabit that river than when the Seneca tribe of the Iroquois confederacy ruled its banks. How many Senecas today are pedologists, teachers, or electron microscopists we do not know, nor how abundantly sturgeon spawned in the coves back when no Seneca could or would aspire to such a life. Since nobody expected to pick up a can of beans after a hard day at the electron microscope, very little forest was cleared for bean acreage. Plenty of tree root hairs kept the soil from silting the river.

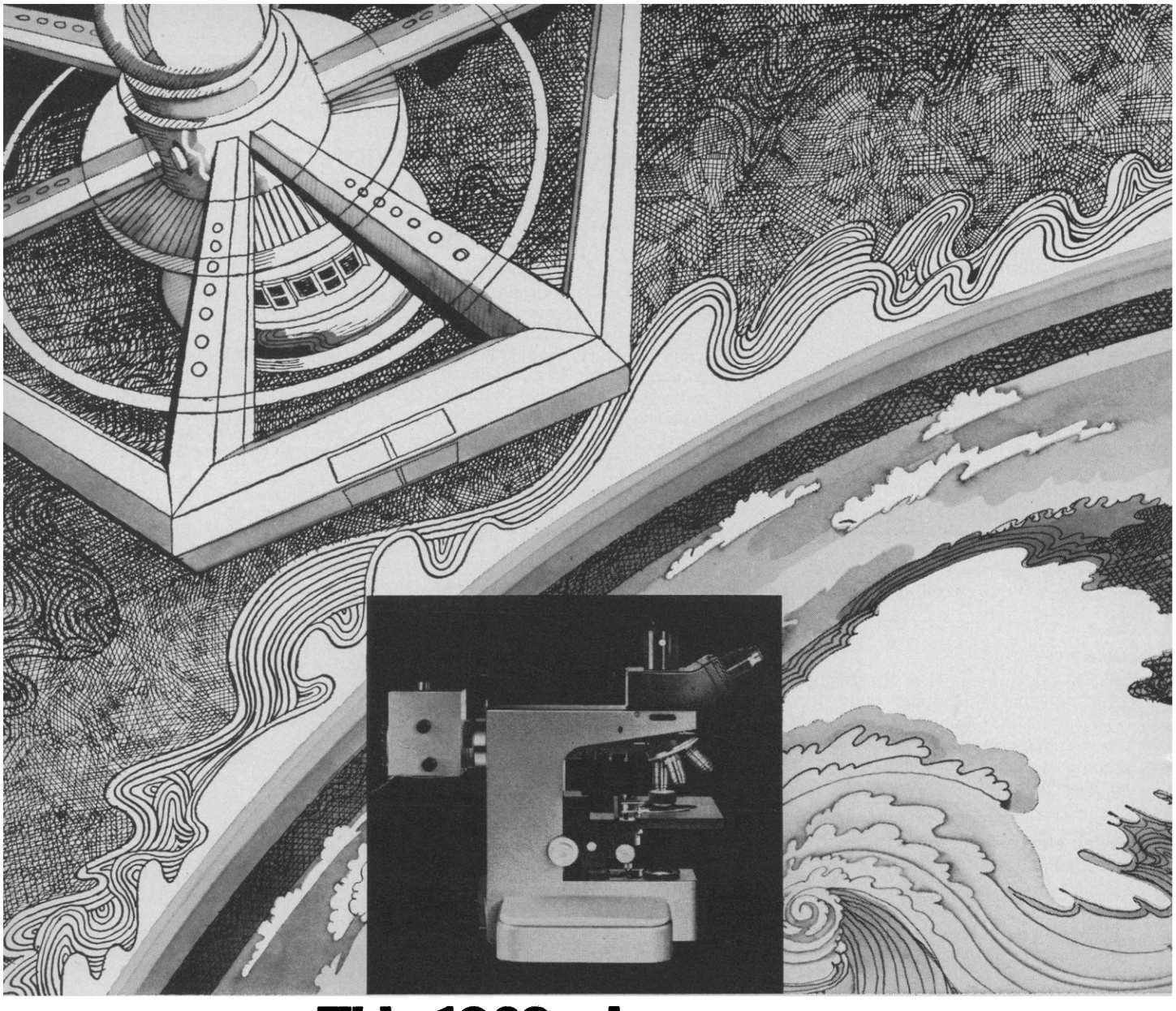
Enough persuasive words have been spilled. It is now dimly seen that convenience sometimes carries too high a price in tawdriness. Let us ask ourselves how far to reverse our mighty engines. Let us give ecologists credit for being as smart as our engineers, chemists, and geologists.

Applied ecology probably cannot restore the exact pre-Columbian state of the river and the lake but might come closer than you think, given sufficient backing. How much do you want to pay?

If you want beans or film at the lowest possible price, it might still be economically feasible to seed the river banks several times a year with mud turtles from a commercial mud-turtle hatchery. You would be able to show the kids a turtle sunning himself on the side of a car that some older kid ran over the bank on a summer night in '62. And that would be that, if you want the lowest possible price.

The cost of reducing and reversing environmental degradation could be put on the same financial basis as the more familiar and traditional price-determining factors. Do you buy that idea?

Now that we are all agreed, next question is how much applied ecology to apply. The United Nations General Assembly has unanimously (!) agreed to hold a conference in 1972 to pick some winning answers. We shall try to anticipate them. Why wait for 1972?



This 1969 microscope is so versatile it will take 1979 accessories.

And 1989 accessories, too. We make sure the ORTHOPLAN *never* becomes obsolete by constantly developing new accessories for it.

Right now, the ORTHOPLAN takes plano objective lenses for biological and metallurgical applications, transmitted-light dark-field and incident-light dark-field attachments, photomicrographic accessories for 35 mm, 4″ x 5″ or Polaroid*. And it also takes different light sources—halogen and xenon, for example.

These are just a *few* of the available attachments that make this fine microscope the most versatile you can buy for your research.

The ORTHOPLAN stand is massive, rigid, and is specially designed so when you attach accessories like lamp housings, illuminators and camera equipment, they become an *integral* part of the microscope—and don't extend out in every direction.

The field of view is up to 2½ times greater than that of conventional wide-field microscopes. It's flat, *edge to edge,* and the image is superb, thanks to the famous Leitz plano objectives.

For more information, write:

Leitz

E. Leitz, Inc.,
468 Park Avenue South, N.Y., N.Y. 10016

*TRADEMARK OF POLAROID CORPORATION.

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30 May 1969, Volume 164, Number 3883 **SCIENCE**

Science as an Instrument of Service

The disaffection of the young has been in the headlines for several years. Some writers claim to understand the phenomenon and have offered explanations ranging from Freudian father-hatred to fear of the atomic bomb. It is not my purpose to offer any additional insight of this dubious kind; rather, I suggest a means of turning the phenomenon to good advantage at the educational level. For there is no doubt that some of our most thoughtful young people see science as a destructive force. Some of this disillusionment stems from a preoccupation with the failings of science, and especially the failings of technology. But people who complain of the increasing pollution of the air never saw England's industrial Midlands, so appropriately named the "Black Country," early in this century, or even Pittsburgh in the 1930's. Viewed on this time scale, air pollution has been strikingly decreased. Similarly we worry about malnutrition in the southern states, but our ability to detect such pockets of poor nutrition is possible only because of our general high level of nourishment. We forget that beri-beri, scurvy, pellagra, and rickets were rampant as recently as 50 years ago, and that the vitamins that cured them have been known to biochemists for barely a generation.

As for water pollution, in the middle of the last century one drank unboiled water at one's peril, and indeed in eastern Europe and Asia one still does; dysentery, typhoid, and even cholera are still widespread in much of the world. Safe drinking water for city dwellers is a relatively recent gain for civilization.

Thus, the jeremiads against our shortcomings are, in the long run, scarcely justified. On the contrary, the record of steady progress can give us confidence that the residual blemishes and pockets will indeed be wiped out as the power of science and technology is increasingly brought to bear on them. And it is here that teachers can have their greatest impact on the idealistic young. For dissatisfaction with the ills of society and a desire to serve mankind could surely lead some to learn how to make use of science. In the past we science teachers have stressed the fascination of science, the unity of science, or the power of the scientific method; it is time now to stress the role of science as an instrument of service and as the means of curing mankind's ills—time to stress the hope of the future as well as the achievement of the past. For in some fields the scientist wields almost unlimited power for good. The International Rice Research Institute, with a staff of only 16 Ph.D's, has apparently changed the whole nutritional future of Asia in a scant 5 years. The doubled or even tripled yields of rice which their work has made possible may save millions of lives in the next 20 years. True, these men had the resources of the Rockefeller Latin American programs to draw upon. But what a tremendous record of service! Fleming and Waksman, with their observations on microbial antagonism, made similar records: penicillin and streptomycin have saved countless lives. And the long-drawn-out miseries of tuberculosis are now, for us of the Western World, largely a thing of the past. One could cite many other instances of science as man's greatest benefactor, and they are not limited to biology. We need new introductory courses, and new textbooks, dedicated to this theme. A new generation of scientists, eager to put their knowledge to use in the service of mankind, may bring the greatest advances yet.

—KENNETH V. THIMANN, *University of California, Santa Cruz*

AUDIOTAPES OF AAAS ANNUAL MEETING SYMPOSIA AND PANEL DISCUSSIONS

Dallas, Texas, 26–31 December 1968

Through a cooperative arrangement between AAAS and Science Service, tape recordings of 15 symposia and panel discussions, presented at the Annual Meeting of the AAAS, are now being released at cost for general distribution. The objective of this undertaking is to make the proceedings of these meetings rapidly available to a wide public.

In a number of sessions, some information was presented on slides. Authors should be contacted directly for copies. Because of a serious epidemic of influenza at the time of the Dallas meeting, a few of the contributions were not given by the originally announced authors.

Tapes are sold as self-contained, half-day sessions. They can be purchased as conventional open reels (3¾ inches per second speed) that can be played back on any conventional audiotape player, or as cassettes for playback on a cartridge player. Each half-day session is identified, for ordering purposes, by a number ("1/68," "2/68," and so on). An order form is at the bottom of this page.

Acknowledgment is made to Ampex Corp. for assistance in recording and distribution and to WAMU, American University, for aid in editing.

The Scientific Research Society of America (RESA) Annual Address and Discussion
- 1/68, 3 hours, $7.00

The Financial Crisis in Science
- 2/68, 3 hours, $7.00

Review of United States Science Policy
- 3/68, 3 hours, $7.00 (Part I)
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Science, Technology, and Latin American Development
- 5/68, 3 hours, $7.00 (Part I)
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- 7/68, 3 hours, $7.00 (Part I)
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- 17/68, 3 hours, $7.00

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- 18/68, 3½ hours, $8.50

The Social Relevance of Physics
- 19/68, 3 hours, $7.00

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- 20/68, 4 hours, $10.00

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- 21/68, 3 hours, $7.00 (Part I, Relation of Territoriality to Dominance)
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- 23/68, 3 hours, $7.00 (Part III, Population Density and Crowding)
- 24/68, 3 hours, $7.00 (Part IV, The Role of Distance in the Evolution of Communication)
- 25/68, 3 hours, $7.00 (Part V, Environmental Conditions and Human Behavior)

Technology and Values
- 26/68, 3 hours, $7.00

Research for the World Food Crisis
- 27/68, 3 hours, $7.00 (Part I, Progress of Research and Technology on Food Supply and Population Control)
- 28/68, 3 hours, $7.00 (Part II)

More complete information about the tapes appears in *Science*, 11 April 1969, pages 113–117.

Use form below to order reels or cassettes. Enclose payment by check or money order. *Do not send cash.* 5309

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Encircle number(s) you want. Tapes are $7.00 each unless indicated otherwise.

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