

SCIENCE

30 May 1969

Vol. 164, No. 3883

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



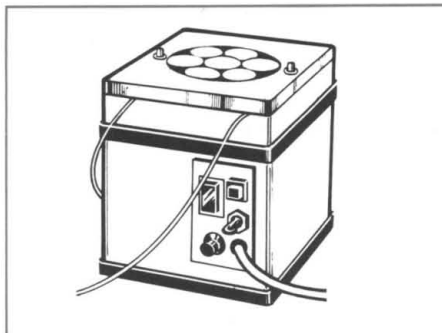
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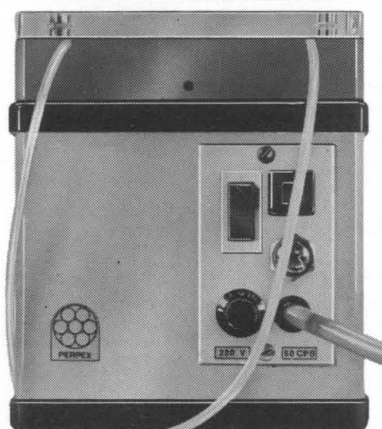
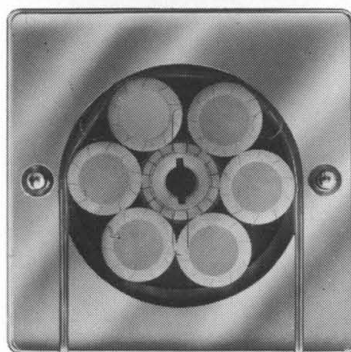
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COVER

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]

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

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.

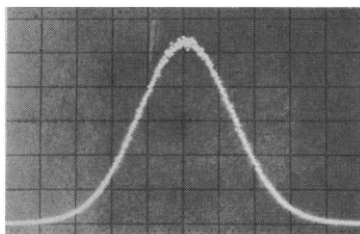
It's not really difficult, with today's more sophisticated electronic instrumentation to measure accurately the energy of a discrete gamma ray and the time of its occurrence. But that's only a small part of the information that the nuclear scientist needs to know. Usually the radiation 'signature' that 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.

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.



Probability density display of
Gaussian noise

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. Boggled 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.

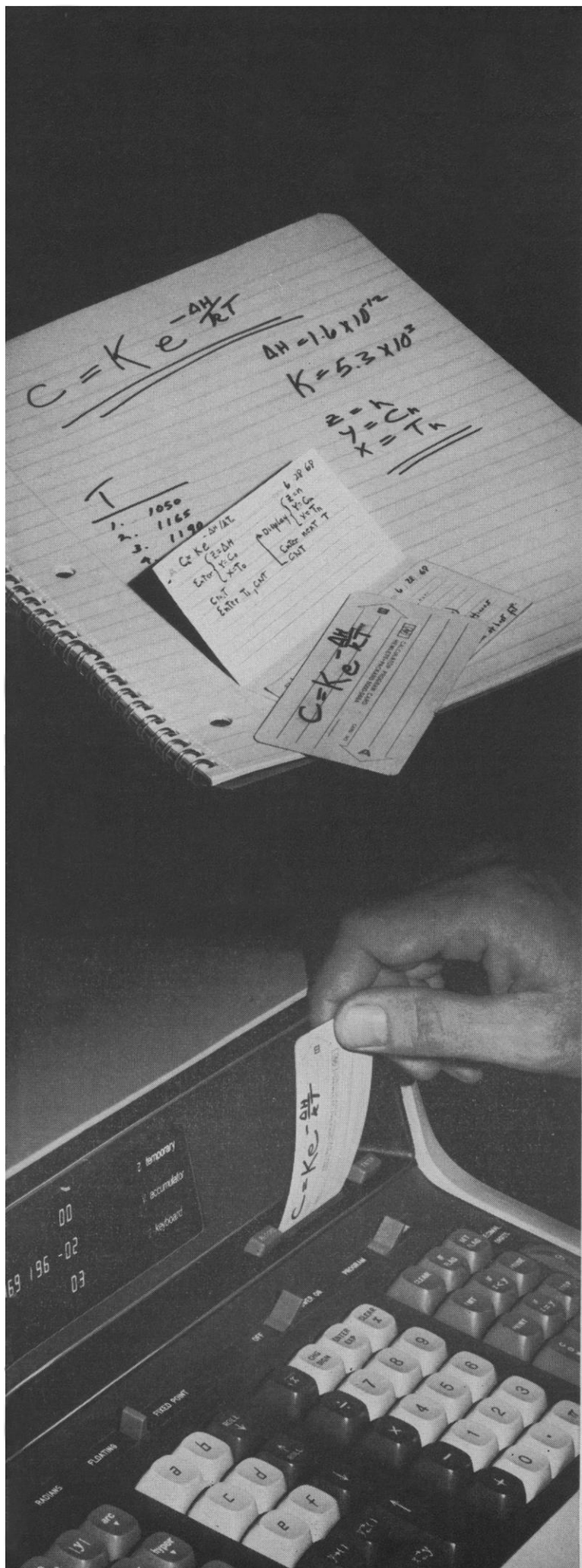
The device which does this job best—the digital integrator—employs even more complex electronic circuits than does the gas chromatograph. And it requires frequent adjustments of a dozen or more programming controls, each somewhat mysterious to the electronics-shy analyst.

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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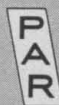
The 170 can also perform:

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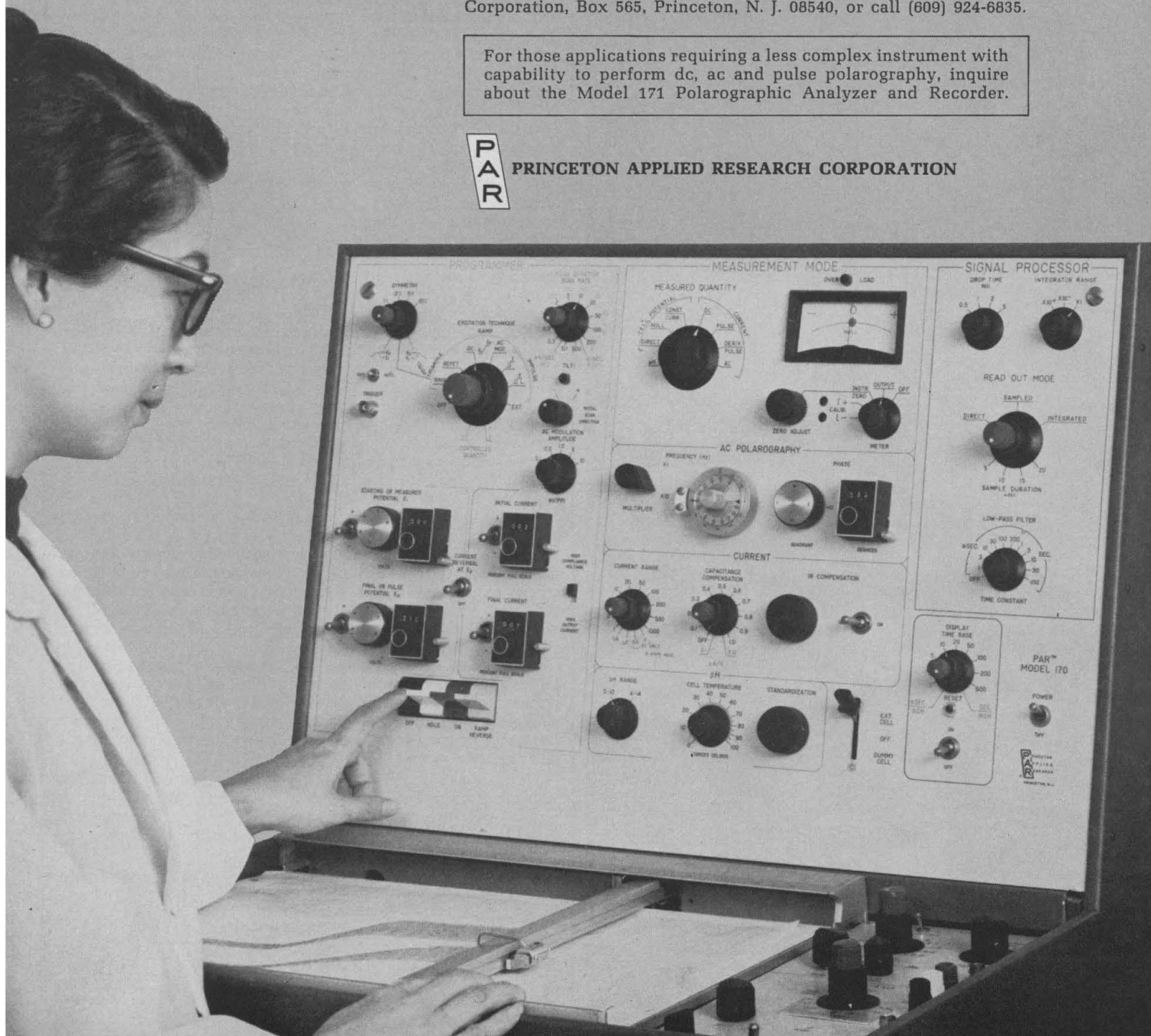
The Model 170 contains a built-in X-Y plotter for accurate current-voltage curve recording as well as a highly stable coulometric integrator and an accurate time-base generator. The only external equipment occasionally required is an oscilloscope.

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.



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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?**

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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.

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a bottle of Bromoform (EASTMAN S45) had a chlorine atom on them. We now know why and how to keep that percentage much lower.

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

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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 microg-

raphers 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.

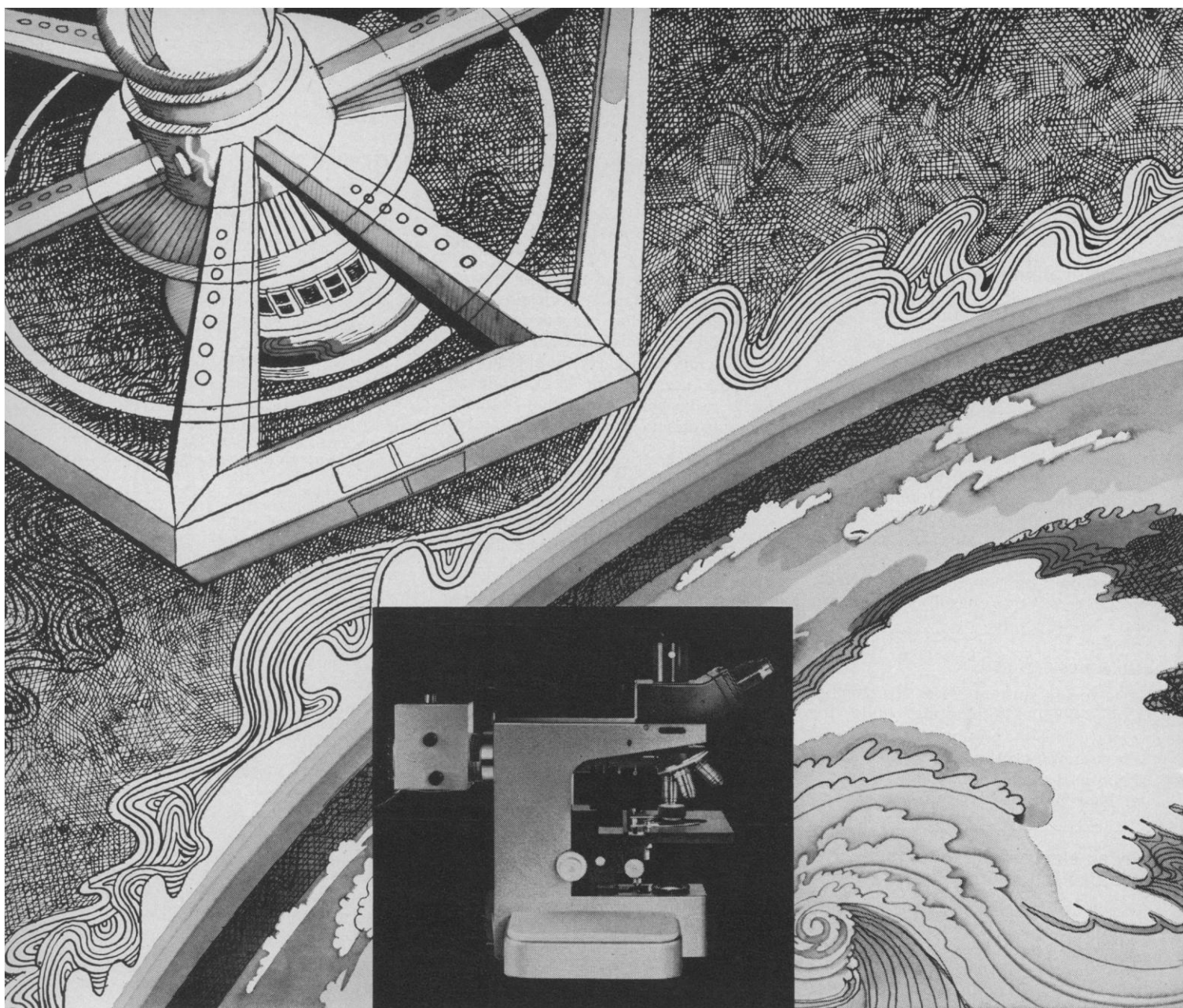
Applied ecology probably cannot restore the exact pre-Columbian state of the river and the lake but might come closer than you think, given sufficient backing. How much do you want to pay?

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?



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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.

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