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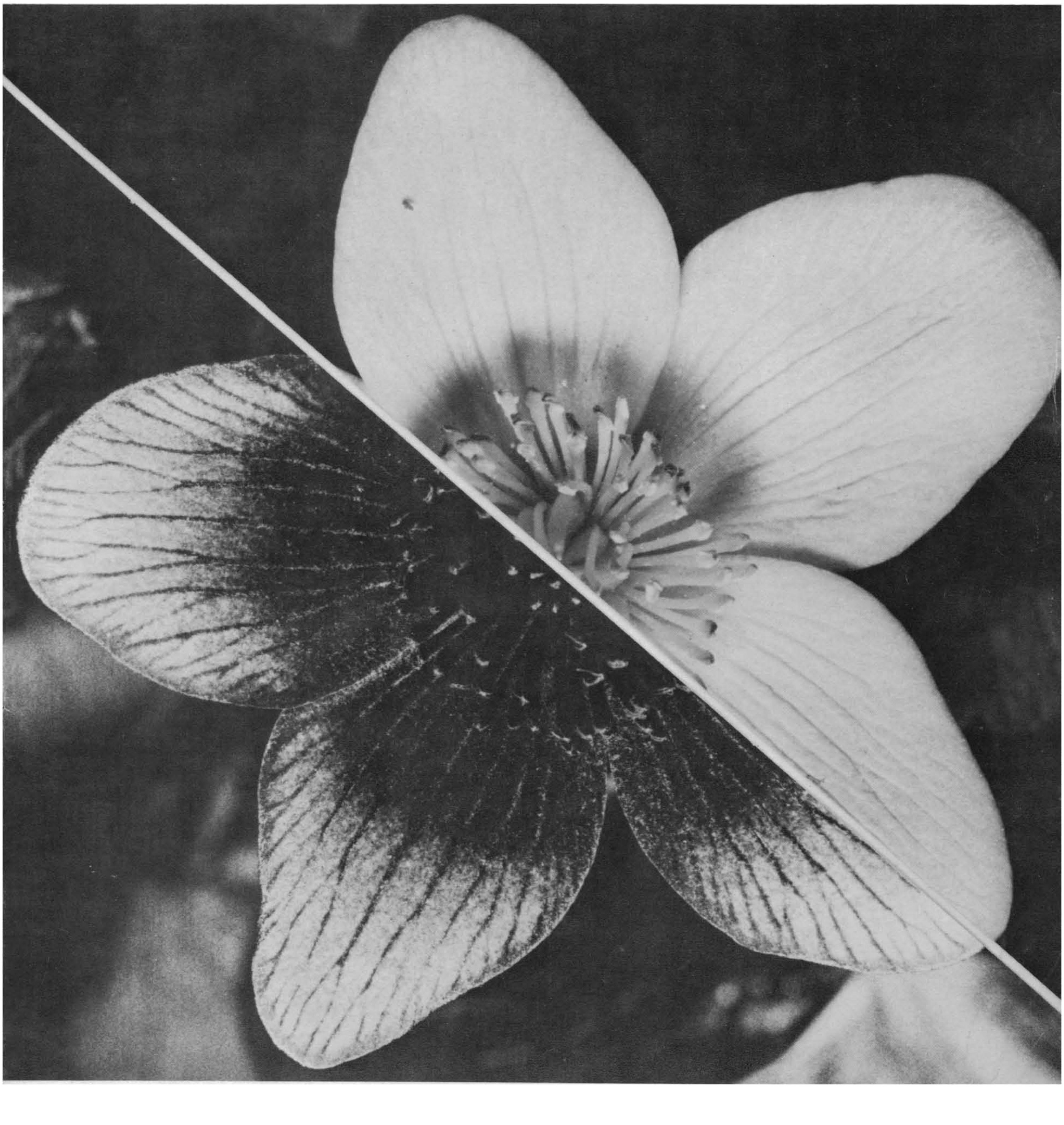


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COVER

The marsh marigold (*Caltha palustris*), which appears evenly yellow to the viewer (right), shares with many other flowers the possession of an ultraviolet reflectant pattern (left), visible only to insects. Such "hidden" ultraviolet patterns are directly observable with a television camera equipped with an ultraviolet-transmitting lens. See page 1172. [T. Eisner, Cornell University]

Scientist or statistician? Some new computer developments are changing things for the better

To the laboratory scientist, the promise of the computer is relief from a growing burden of rather boring statistical work. He is much less interested in the computer's nanosecond-speed and the bit and word-size of its memory than in its ability to accumulate data, plot graphs, make long calculations and generally perform the non-creative tasks that increasingly are reducing his effectiveness as a scientist.

Given the chance, the computer can live up to its promise. But in all too many laboratories, the computer doesn't even stand the chance of a trial because it creates new problems that some scientists consider to be worse than the old. Chief among these is the complexity of putting the computer to work in the laboratory—programming it, mastering the instrument-computer and the man-machine interfaces—which, to the scientist, is often a greater drudgery than the manual data gathering and calculations that the computer eliminates.

Two more or less recent advances in technology will make the computer more readily acceptable to the reticent scientist. The first is the small, instrument-oriented digital computer, a relatively low-cost ($10,000-$20,000) machine with easy-to-use controls, often pre-programmed to do a specific job . . . as in the lunar sample analysis experiment described later. Second is the growing popularity, at lower and lower cost, of shared-time computer leasing, which reduces the physical presence of the computer in the lab to nothing more complex than a typewriter-like keyboard. When coupled with the availability of packaged programs developed by instrument manufacturers for a specific analytical purpose—as in the simulated distillation article described next—shared-time computers will satisfy increasingly larger numbers of scientists.

In both cases, the scientist can capture the advantage of the computer without suffering its complications. Use of the computer requires nothing more complex than answering a computer-initiated dialogue in English and mathematical terms that are already familiar to the analytical technique in question . . . and entering the answer on a keyboard that requires no more than a "hunt and peck" typing skill.

Shared-Time Computer Helps GC Simulate Distillation

A far cry from the alembic used by the 16th century alchemist, the artful glassware used by the modern oil chemist for True Boiling Point (TBP) distillation nevertheless employs the same basic technique: boil and condense. To this day, TBP distillation remains the only accepted way to establish the basic marketing specification of petroleum products . . . and it leaves a lot to be desired. Those who refine petroleum products don't like it because it takes so long: TBP distillation of a wide-boiling distillate can take as long as 100 hours, and the results are useless in controlling the operation of a refinery. Those who buy petroleum products don't like it because the method is not very reproducible, especially as it applies to the initial and final boiling points. Those who perform the distillation don't like it for both of these reasons and because the procedure itself is a long and boring task.

A group of scientists at HP's Avondale Division have devised a completely automatic method that employs gas chromatography (GC) to simulate distillation and produces boiling point distribution data more precisely and in much less time—about 10 minutes—than TBP distillation. The new method employs the HP 7600A Chromatograph System which is capable of automatic unattended operation from sample measurement and injection through GC analysis and digital readout of integration data.

The recipe for simulated distillation with the 7600A is relatively simple. After installing a non-polar column of limited efficiency (most of the methyl-silane silicone rubber phases are satisfactory), set the GC for a linear program of 6 to 10°C/minute starting at −20°C, load the sample tray with as many as 36 different calibration and analytical samples, even of widely diverse boiling ranges up to 1000°F . . . and push the *start* button: the rest is automatic.

The 7600A automatically injects the samples and prepares a punched tape record of the GC retention time and area measurements at precise time intervals. Complete sets of programs provided with the 7600A enable any of the principal time-sharing computer services (including the HP 2000A Time-Shared System) to read the punched tape data, determine the initial and final boiling points of each sample, assign boiling temperatures to each data point and print out the analysis report of boiling point distribution of each sample at 1% increments.

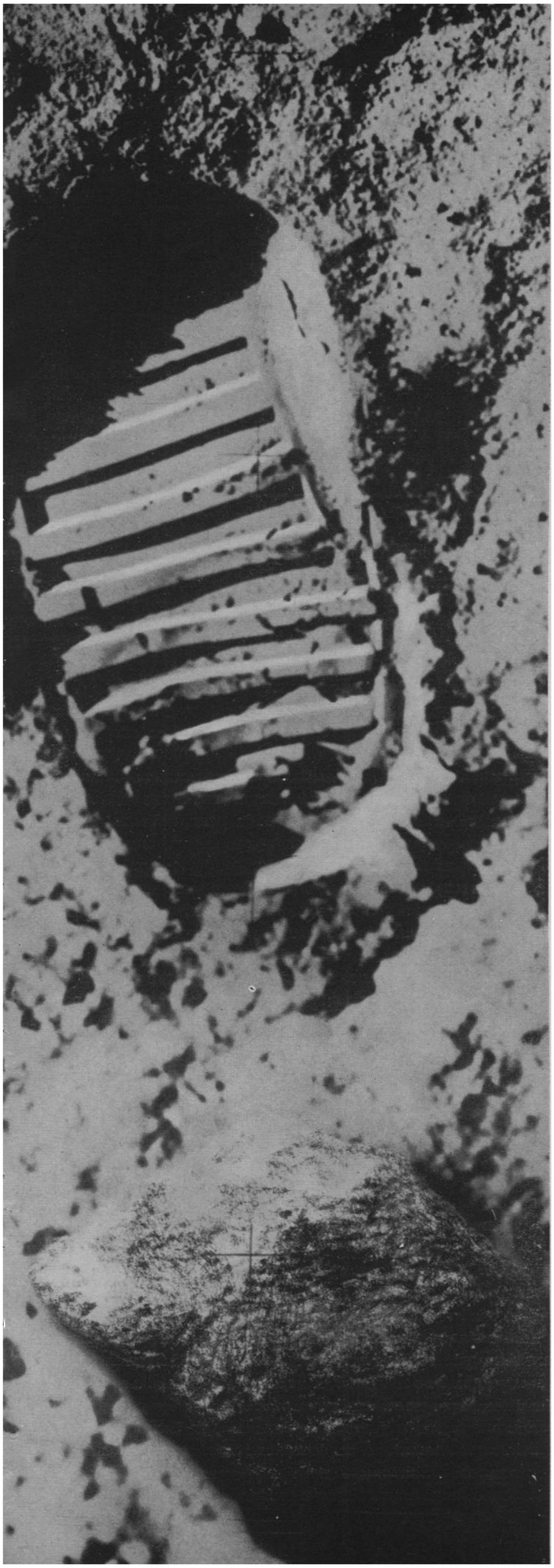
No knowledge of computer programming is required by the analyst. At each stage of the computer-performed calculations, the computer asks for the information it requires and the operator answers by typing the requested number or word on the time-share terminal keyboard.

The precision of the 7600A Simulated Distillation method with wide boiling range samples is greater than is possible by any distillation method. Its speed—an average of 10 minutes per sample—completely outclasses distillation methods.

This new automated Simulated Distillation method is examined in much more meaningful detail in Vol. 2, No. 3 of *Analytical Advances*. Request your copy today.

Dedicated Computer Extracts hidden information from Lunar sample

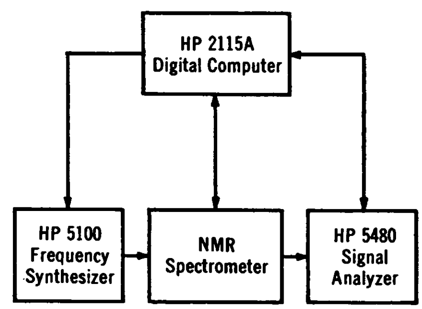
Some of the most respected scientific teams in the U.S. and eight foreign countries are performing analytical investigations on the lunar material returned to earth by the Apollo 11 crew. Among the 100-odd investigations scheduled by NASA, a nuclear magnetic resonance (NMR) analysis will be conducted by a Jet Propulsion Laboratory team headed by Dr. S. L. Manatt. Its goal is to characterize hydrogen nuclei in lunar material and attempt to establish whether any of it can be traced to free or crystalline water molecules presently on the moon's surface. The JPL scientists will also be on the lookout for heavy hydrogen whose presence will allow some conclusions about the history of the moon's surface and about the effect of the solar wind. A study



of oxygen-17 may give them important clues about the current chemical environment of the moon (from surface samples) and about the presence of a lunar sea or ocean in the distant past (from core samples).

Present-day commercial NMR spectrometers are capable of accomplishing, unaided, the work assigned to the JPL team with a creditable degree of success. But when you're analyzing samples that cost about a million dollars a gram to acquire, you're not satisfied with anything short of the best possible performance from your analytical instruments.

In the JPL team's quest for enhancing NMR sensitivity, they devised a system that combines the NMR spectrometer with a frequency synthesizer and signal analyzer under the control of a small digital computer, the HP 2115A, dedicated to this task alone.



The computer-controlled system extracts very weak NMR signals from heavy noise, enhancing instrument sensitivity as much as 100 times. It also performs fast Fourier Transforms of the NMR signal, converting it from time to frequency domain, for a further increase in sensitivity of another order of magnitude.

Here's how it works: the computer digitally sweeps both the frequency synthesizer and signal analyzer through programmed frequencies. Synthesizer output excites the NMR spectrometer which develops noise-covered resonance spikes for each nucleus in the lunar sample; under computer control, the frequency synthesizer also shifts NMR excitation between the resonance and transition frequencies of the nucleus under observation, thereby permitting measurement of relaxation or resonance decay times: The NMR output signal is fed to the signal analyzer which extracts the data from the noise and presents a calibrated display of the average signal at all times. The computer then processes the waveform, converts it from time to frequency domain by Fourier transformation and displays the result immediately in analog as well as digital form. End results of computer-controlled signal averaging and Fourier Transform is to increase spectrometer sensitivity as much as a thousand-fold. (Photo courtesy of NASA.)

Detailed information on HP Signal Analyzers and Computers is available on request. Write to 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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exists. I can only echo the warning of Auden—if we concern ourselves with "scales too gigantic or dwarfish," we are in danger of being totally ignored by a world that can do so only at its (and our) own peril.

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Why Europe's Grass is Greener

As a former Englishman and an avid gardener who has lived in the United States for almost 12 years, it is easy for me to see why Abelson finds flowers almost everywhere in Europe and seldom in the United States ("Microcosms in a world apart," 29 Aug., p. 853). The extremes of temperature found in most American cities make flower growing difficult, and an operation that requires constant attention. In contrast, in most places in Europe one can plant flowers and almost forget about them. In San Francisco, where there are not the extremes of temperature, there are flowers that will rival any European display. A visit to the Golden Gate Park or Union Square should prove this point.

Perhaps Abelson has also slighted Chicago. Recently my family and I were in the Lincoln Park Conservatory where we saw a breathtaking display of orchids, and my children were able to see bananas growing. In the zoo and farm area one can see animals from all over the world, watch cows being milked, or take a leisurely row on the lagoon. . . . I agree that there is room for improvement, but must protest that if the grass is greener on the other side of the Atlantic, perhaps it is just because the weather is more conducive to growing green grass.

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Ecology Crossfire

Fahnestock (Letters, 3 Oct.) advises us to distinguish between what is ecologically necessary and that which is merely ecologically desirable, urging us to banish emotion so that we can make the distinction honestly. His contention that bald eagles, for example, aren't really necessary leads to the view that esthetic values have no ultimate place in any sensible scheme for regulating our environment; that is, we do not need to be other than dull. Furthermore, I wonder if it is not a bit emotional to stump for that which is ecologically necessary only for our exclusive selves. If it were shown that smog had a worse effect on man than on bald eagles, shouldn't some of us then promote air pollution to prove our complete scientific detachment?

Fahnestock says also: ". . . we seem to be getting along pretty well without the moa, the dodo, and the passenger pigeon." Not so. I am perfectly miserable without them.

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Jukes' interpretation of the ecological effects of DDT (Letters, 3 Oct.) does not conform to the prediction, made long ago (*1*), that the effect of an agent which increases the mortality of both predator and prey in a two-component system is to decrease the average numbers of the predator and increase the average numbers of the prey. This is why the usual effects of broad-spectrum biocides in simplified systems (such as agricultural croplands) is to increase the numbers of phytophagous insects and to decrease the numbers of their predators (or parasites) (*2*). In ecosystems with more than two trophic levels, this effect may act on any pair, or on more than one pair, of species; ecological theory at present gives no way to predict which pair will be affected most.

DDT and other persistent pesticides mentioned by Fischer (*3*) are present in almost every ecosystem (*4*). Hence, whenever a species is observed to increase suddenly while its predator (or parasite) decreases, it is reasonable and logical to propose, as Fischer did, that a persistent pesticide *may* be responsible. This, of course, is only one of a number of alternative hypotheses which must be investigated simultaneously in every ecological situation . . . (*5*).

I. C. T. NISBET
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References and Notes

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Selling environmental awareness

If all goes well in the next three gift-buying weeks, many families will acquire fine new cameras.

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Teach your children, says this doctrine, that any weather can be enjoyed with a grateful, interested eye and mind. Also any worm, any spider web, any leaf, any large rock, any small shell. Environmental awareness makes it worthwhile to be alive. As awareness ripens here and there into understanding, satisfaction may increase.

A camera finder in front of the eye helps build awareness. This has been proved in slum and suburb, and for other aspects of reality than spider webs. It's like the difference between thinking important thoughts and actually having to express them.

In the summer past, fifteen of our men were paid to spend their time in five national parks giving shows on this theme. Parks ought to be more than places where it is easier to smell the next family's cooking than at home. "Take nothing but pictures, leave nothing but footprints," says the National Park Service, concerned about excessive success.

If the park visitors are lucky, it will occur to them on looking at the pictures that equal beauty is also to be found nearer home.

In a corner, a sequenator hums

Just as there are places on earth where religion has long been automated by wind-driven prayer wheels, there is now automatic equipment on sale for determining the sequence of amino acid residues in peptides and proteins.

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The celebrated Edman and Begg paper (*European J. Biochem. 1:* 80 (1967)) laid on the line for all the world to read just how to build an automatic sequenating machine and how to prepare the required chemicals. Now, some three years after the paper was received by the journal, several instrument companies offer the biochemist their improved versions of the sequenator, while we with our reagent-making experience and facilities further free him from tasks that will little profit his reputation.

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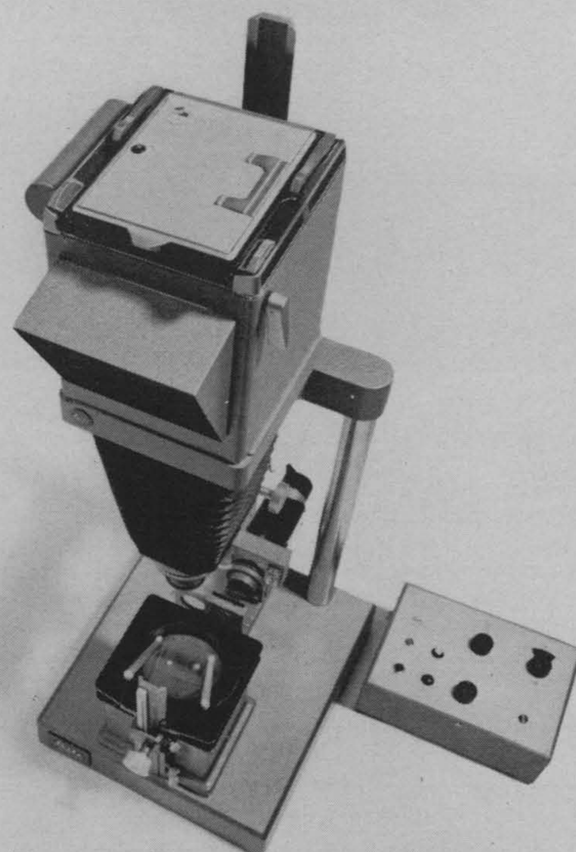

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Support of Science on the University's Own Terms

The faltering in the public support of science in America points to a deep and disheartening conclusion: Science has established no secure claim in its own right upon the priorities of our national treasury. A generation of time and billions of dollars of public funds should have secured a deeper understanding of the meaning of science on the part of contemporary Americans. Instead, much of the actual experience has created downright misunderstanding.

At the end of World War II, the American taxpayer became the world's leading patron of science. For the next 20 years, public money flowed in increasing volume to the support of science. The rising curve of public support began to level out in 1965, and the support of university science is now down about $250 million from the 1965 peak of $1.3 billion. No one could deny that the ample flow of public funds set off a golden age of science in America. The country's universities and the scientific enterprise have yet to reckon, however, with the costs exacted by the terms on which the funds were extended and accepted. Now that the tide is ebbing, these costs are being revealed. It is clear that the harm done to science and the universities at the flood far exceeds any damage at the ebb.

The scientists were content to accept funds from whatever source was ready to supply money most generously. They thus permitted the major funding of their work to come as a by-product of mounting public expenditures for other purposes, especially for weapons. University administrators, for their part, were glad to have the scientists on their faculty take on the task of obtaining the money.

A university is a moral community, bound only by the common cause of the increase and diffusion of human understanding. In each of our foremost universities, the federal funding of science has exerted pressures tending to divide and dissolve that frail community. At best, it has installed and expanded scientific departments and enterprises in the universities and their medical schools without regard to the needs and priorities of the university as a whole, and often without regard to the educational process. At worst, it has established in the universities entirely inappropriate activities, motivated by the interests of the mission-oriented granting agencies and often inimical to free inquiry and to the humanity of science. Among the members of the faculty, the community has been divided on the line between the arts and sciences by the meanest issue of compensation and status, and dissolved by the transfer of the scientist's allegiance from his university to the invisible college of his field that controls his financial support in Washington. Between faculty and students, division and dissolution of the community has followed from the drafting of our scientific resources for the escalation of violence that has come to substitute for foreign policy over the past 25 years.

When the present crisis has passed and we can turn to the reconstruction of our universities, a first essential step will be the reconstitution of their relations with the federal government. The initiative and decision in the deployment of research funds must be restored to the universities. Administrators and scientists must insist that public funds be supplied on terms that respect the independence of the scientist and the autonomy of his university. If these are to be the terms, then the public at large must be persuaded soon that science is an enterprise to be supported as an end in itself, as an exercise of the capacity that most nearly makes each of us a human being, as an expression of the civilization of our society.—GERARD PIEL, Publisher, *Scientific American*

This editorial is adapted from remarks made on the occasion of his acceptance of the Arches of Science Award of the Pacific Science Center, Seattle, Washington, 21 October 1969.