

SCIENCE


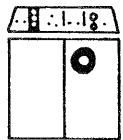
13 September 1968

Vol. 161, No. 3846

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

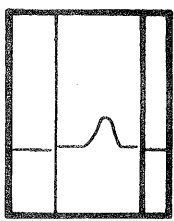
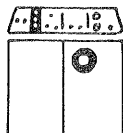
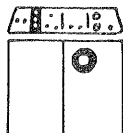








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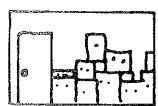
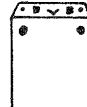
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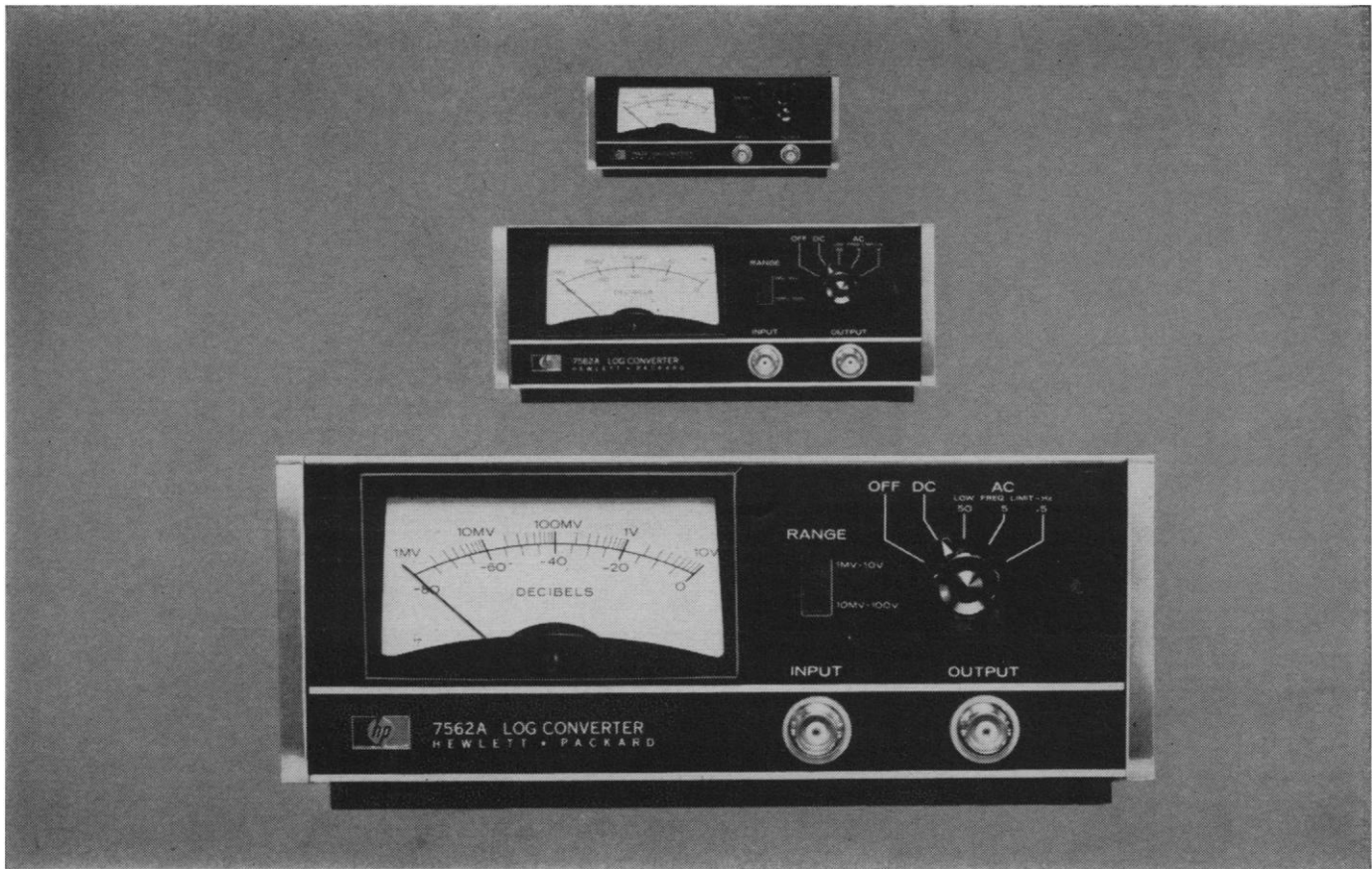
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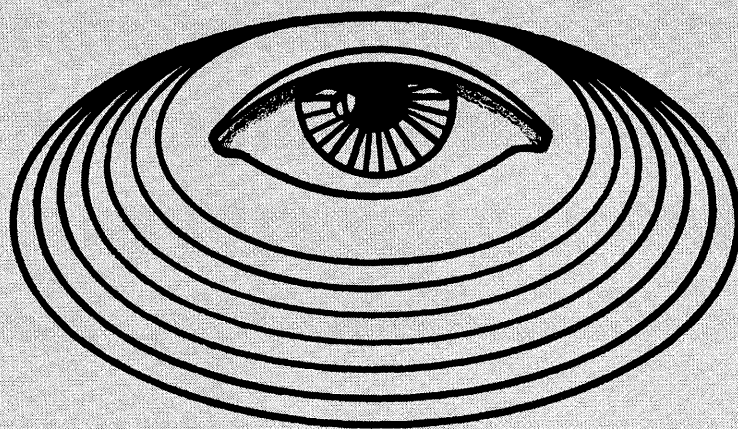
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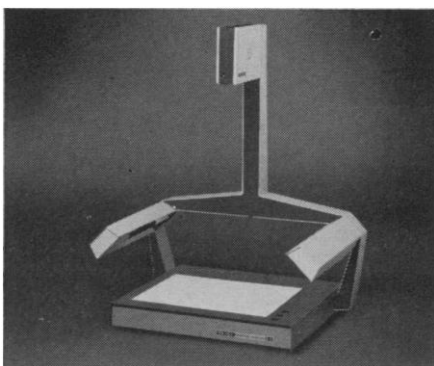
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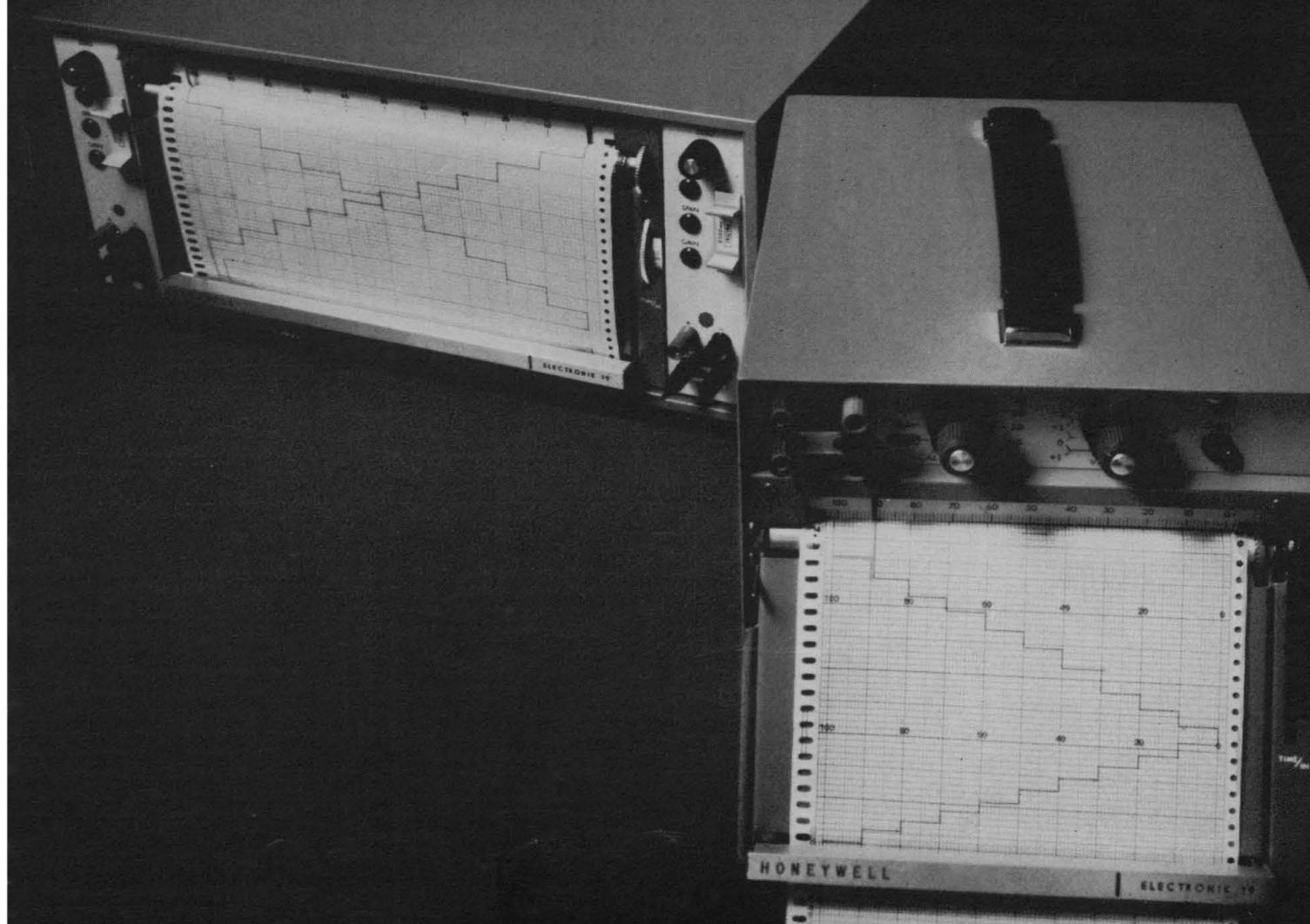
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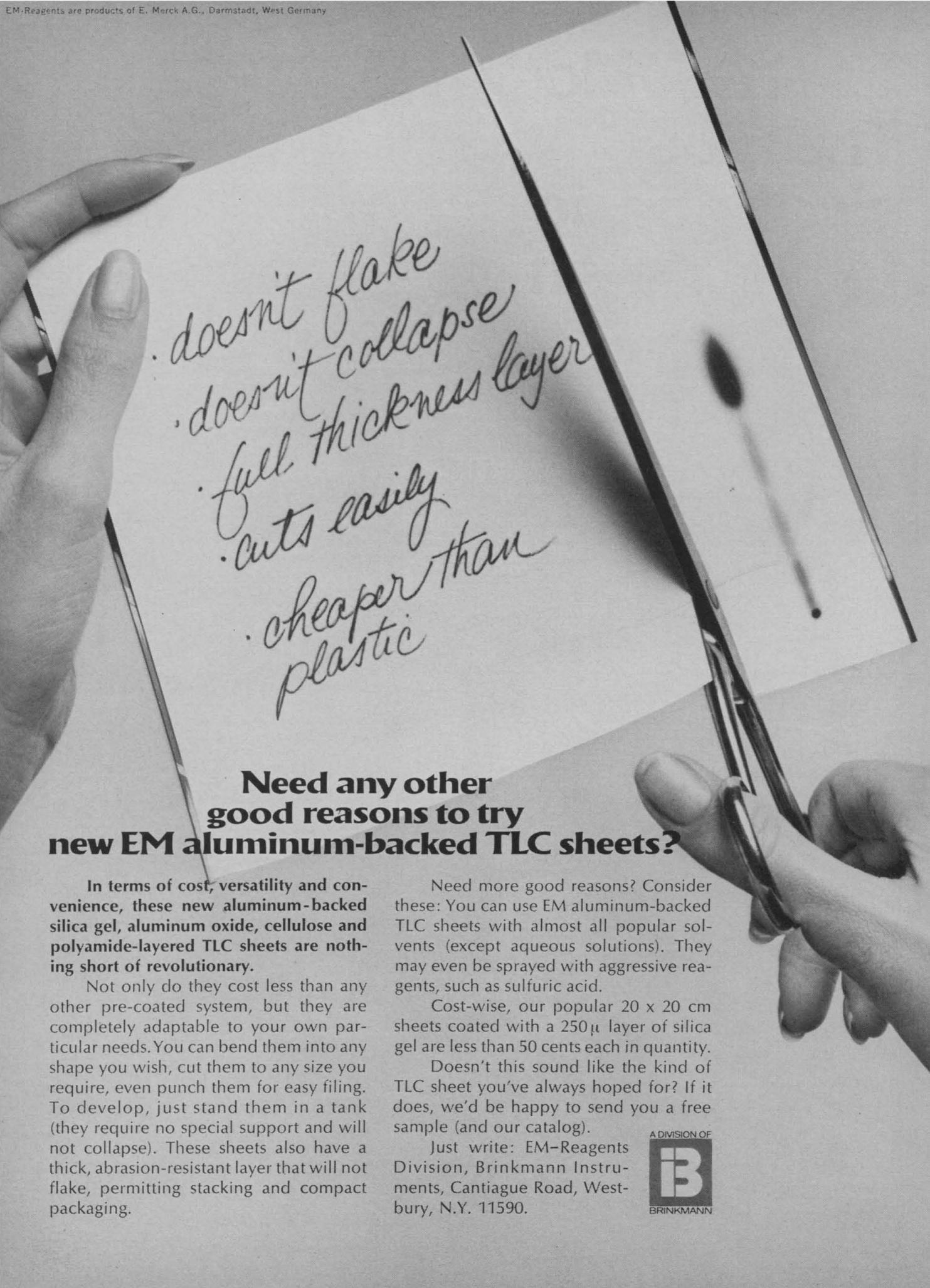
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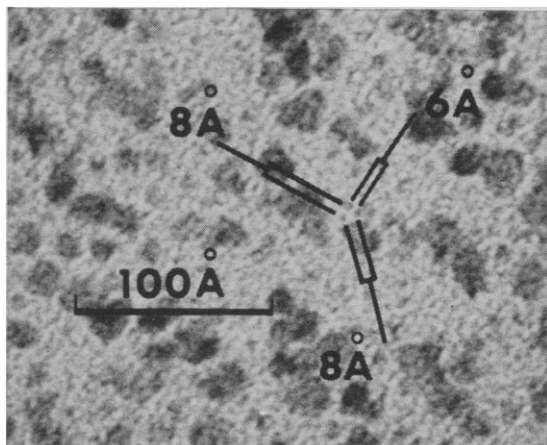
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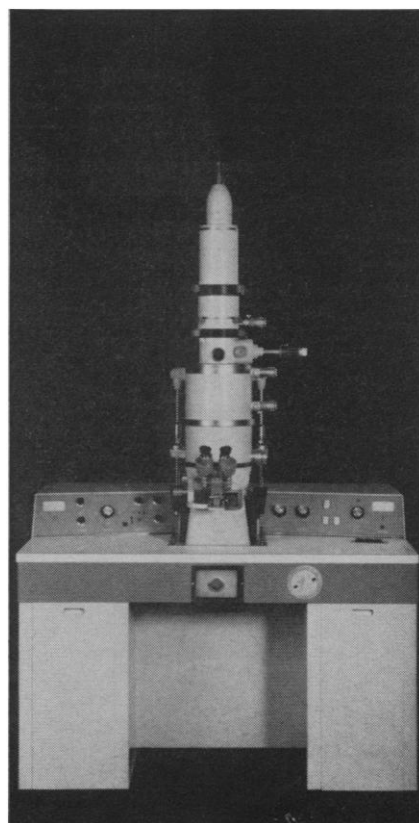
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How to See Through 1000 Windows at a Time

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.

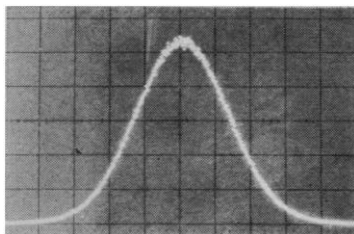
It's not really difficult, with today's more sophisticated electronic instrumentation to measure accurately the energy of a discrete gamma ray and the time of its occurrence. But that's only a small part of the information that the nuclear scientist needs to know. Usually the radiation 'signature' that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

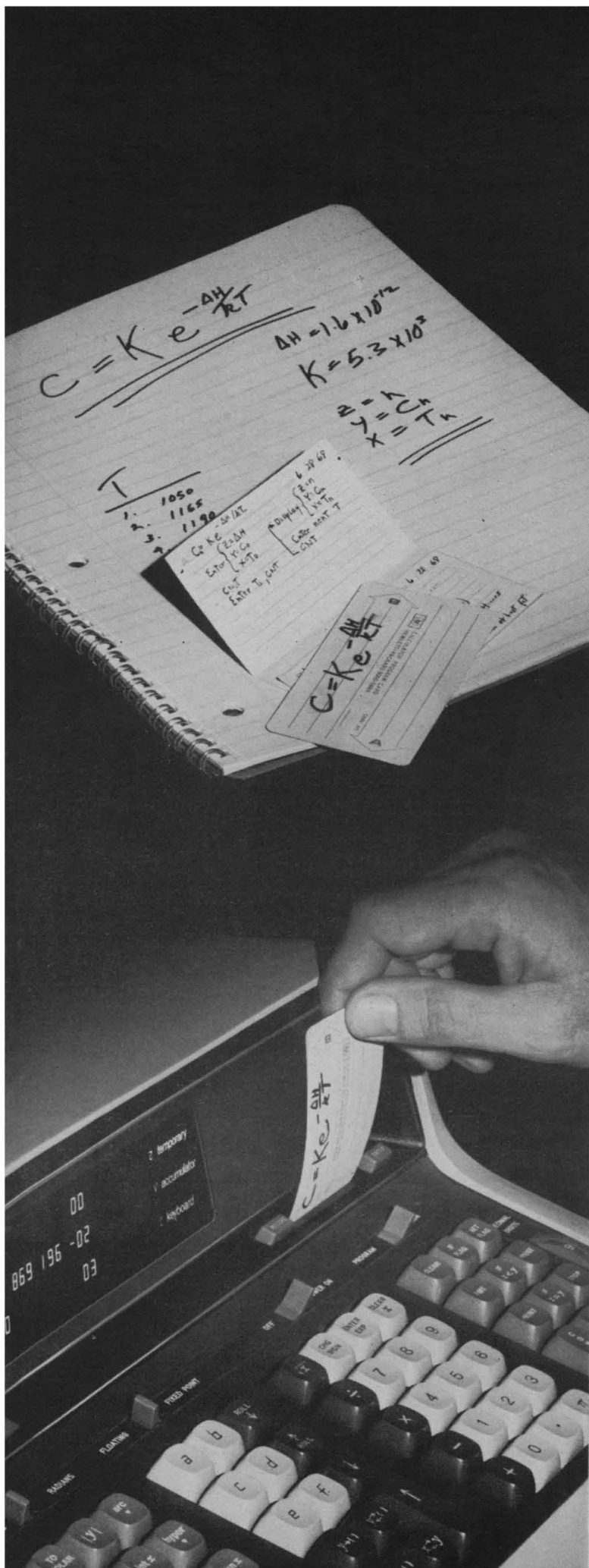
The device which does this job best—the digital integrator—employs even more complex electronic circuits than does the gas chromatograph. And it requires frequent adjustments of a dozen or more programming controls, each somewhat mysterious to the electronics-shy analyst.

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.

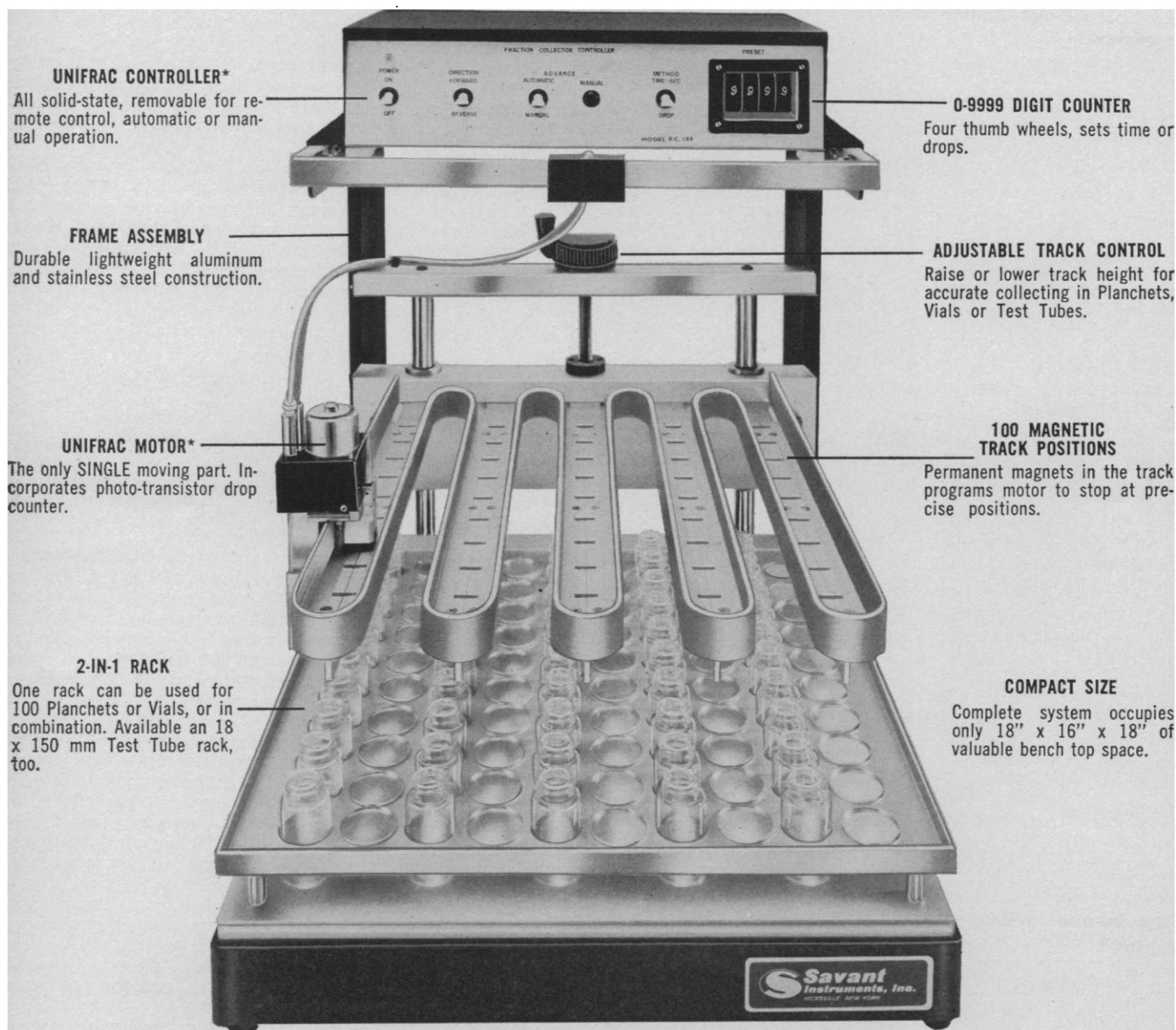
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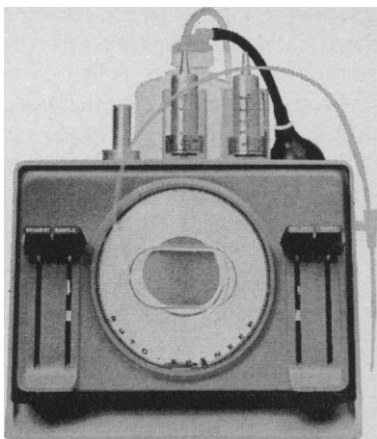
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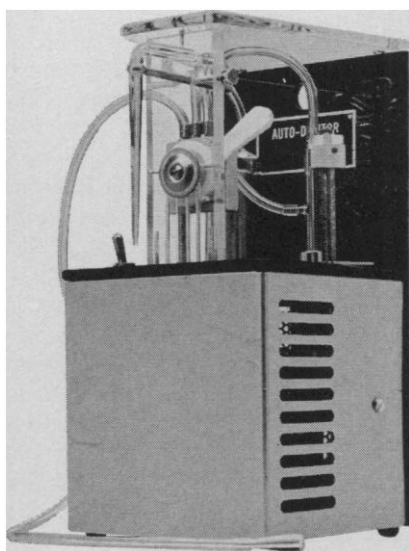


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be a misconception of the democratic principle. Ideally the responsibility of the governing majority is for the whole people. It seeks to reduce the differences in the common interest. Through use of the best possible intercommunication with the minority and the individual, it strives to dissipate tensions and win compromise, if not understanding.

Conceding a moral right to break the law would appear to be a confession of the failure of democracy. Our country has already yielded too much of the democratic ideal in the case of the "conscientious objector."

... But whether it is the legal exemption of the conscientious objector or the moral exemption of the self-justifying lawbreaker, the individual citizen becomes not only an independent moral authority but something of a lawmaker as well—all of which appears a bit anarchic to my mind. . . .

J. B. RHINE

*Institute for Parapsychology,
College Station, Durham,
North Carolina 27708*

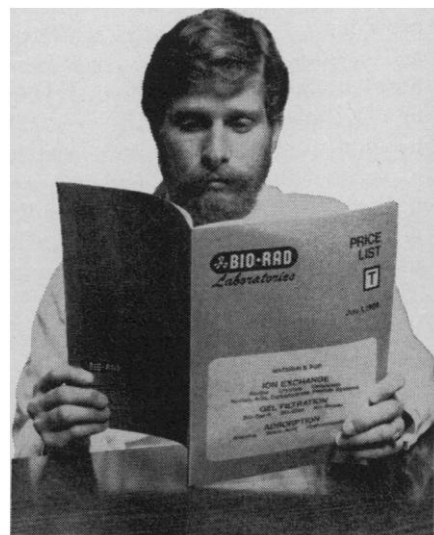
It is surprising to encounter solecisms in Wolfe's editorial. Justice Fortas, whose recent essay *Concerning Dissent and Civil Disobedience* stimulated the editorial, is permitted such legerdemain: Fortas is a lawyer, and lawyers are trained to confound and to employ logic dialectically.

1) The freedom "to speak freely and protest effectively" (*ex Fortas*) is activity and entails further activities. So it makes no sense to say that exercises of First Amendment rights must be judged by the consequent actions "rather than motives or thoughts." To imagine such a disjunction between motives, thoughts, and behavior is not only to subscribe to a passé legal fiction, but also to consign science and the intelligentsia to the status of a bauble.

2) Actions which "endanger others and infringe on their rights" are of course, *ex def.*, "unlawful" if reference is to positive law. (That is not quite accurate, since official action that endangers people is lawful, except in cases where subsequently it is officially decided to have been unlawful.)

3) To assert next that "the [legal] consequences must be accepted" by those who disobey laws which they deem to be immoral is to beg the question altogether—the question being, under what circumstances, if any, should the law be set aside to satisfy the claims of morality? The reasoning of the edi-

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torial could not distinguish Eichmann from Dr. Spock, because it values legal coercion for its own sake.

4) "The rule of law" is offered as the logical and ethical underpinning of this line of thought. To be sure, the rule of law is not a term of art among jurists. It is a political slogan which celebrates the values of compliance and due process. What it means is that disputes should be settled according to rules agreed upon in advance of the dispute, administered impersonally, and stated sufficiently precisely for people to be able to anticipate the risks of liability. Hence, "the rule of law" is procedural, has no substantive contents, and cannot possibly be relevant to political disputes in which the interpretation or validity of a particular law is in issue. . . .

Those who agreed with the sentiment behind Wolfe's editorial will be protesting to themselves that it was never intended to be understood in this way. That means that it was never intended to be understood, period; it was meant to be agreed with.

DONALD A. STRICKLAND
Department of Political Science,
Northwestern University,
Evanston, Illinois 60201

The editorial stated that "the term *civil disobedience* is widely misapplied." That term can be defined as the refusal to obey civil laws, especially, as Webster's puts it, "as a nonviolent collective means of forcing concessions from the government." The alleged crimes of Messrs. Sirhan, Ray, Oswald, and Eichmann are in a different domain.

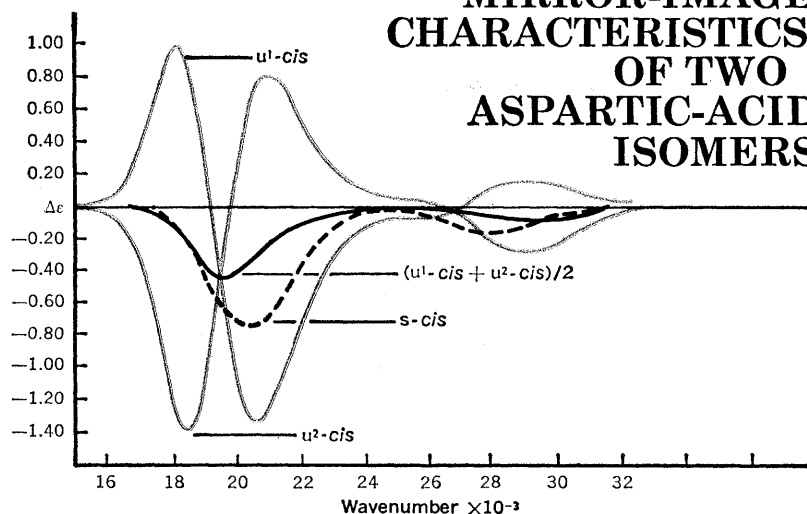
Bagnall briefly, and Rhine more fully, hope we can rely on majority rule. So does the true civil dissenter (but not the violence monger who may come along at the same time). He accepts the principle of majority rule; he wants the majority to change a law; when he concludes that other means of persuasion will not succeed, he uses civil disobedience to emphasize and dramatize his case. He is saying, "I believe this law to be morally wrong. I believe it so strongly that I violate the law and expect to be punished. But I hope thereby to convince you that the law is wrong and that you should change it." Although he is violating a particular law, he accepts what Strickland called "rules agreed upon in advance" or the editorial called "the rule of law."

The sentiment behind the editorial was, I thought, clear and cogent. It is the desirability, in a period of much

CHEMICAL PROFILES

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PROVING THE MIRROR-IMAGE CHARACTERISTICS OF TWO ASPARTIC-ACID ISOMERS

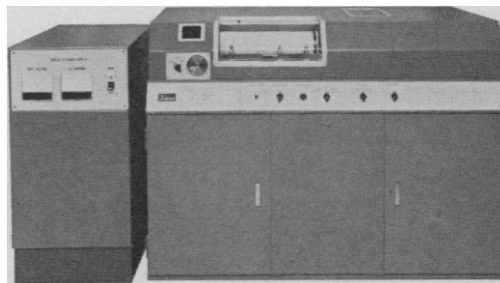


Aspartic acid, with its three donor sites, can form a variety of hard-to-identify chelate isomers. The circular-dichroism profiles drawn here, plotted from data gathered by a Durrum-Jasco CD recorder, are typical of the molecular detective work* that can be achieved with this versatile instrument.

The steric requirements of aspartic acid indicate that in a cobalt-diethylenetriamine complex, three isomers will predominate: one *s-cis* (symmetrical), shown as a dashed-line profile in the drawing above, and two *u-cis* (unsymmetrical) isomers, shown in color. The latter are essentially mirror images of each other, and the Durrum-Jasco instrument provides a way to identify one from the other.

The configurational contributions to the CD traces of the two mirror-image isomers should, in theory, cancel out, leaving an "average" trace that approximates that of the *s-cis* isomer where there are no configurational contributions. As seen here, a very close correlation is achieved, proving that the two *u-cis* isomers are indeed pseudo-mirror images and providing clues as to their specific forms.

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*AS REPORTED BY J. IVAN LEGG AND DEAN W. COOKE IN THE DECEMBER 20, 1967 ISSUE OF JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

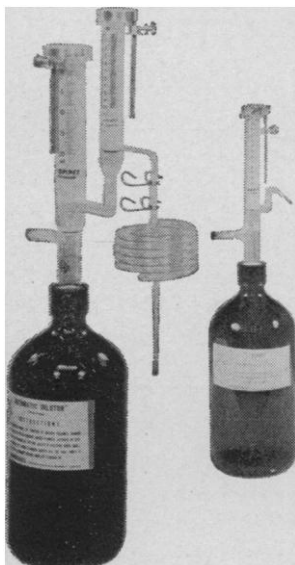


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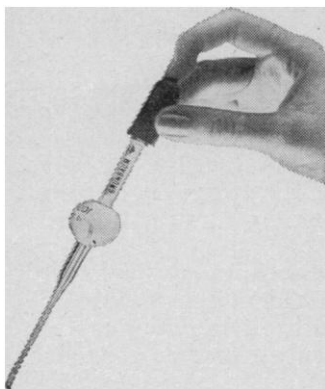


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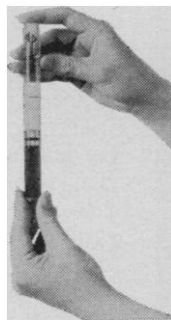
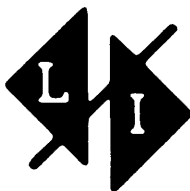
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controversy—which concerns a variety of issues and is expressed in a variety of ways—of understanding the constitutional principles concerning dissent and civil disobedience, and of discriminating among the various means by which disagreements are expressed. I am sorry Strickland misunderstood.

DAEL WOLFLE

Funding: Long-Term or Annual

Two recent articles ("The status and problems of high-energy physics today," 5 July, p. 11; and "Government agencies preparing to reduce spending," 12 July, p. 143), and an editorial (28 June, p. 1400) have all emphasized how costly national scientific efforts become when there is uncertainty as to the actual amount of federal support forthcoming in a fiscal year. Perhaps the most spectacular instance of this was Project Mohole on which large sums were spent until Congress abruptly cut off further funds, and thus wasted the efforts of the scientists and all the money previously expended.

Under present appropriation procedures many projects are authorized by legislation which contains a specific dollar ceiling and expires every year. The ceiling must thus be reviewed annually on each extension by the House and Senate. Following this, appropriations must be considered in each house. This involves four separate instances when the fate of the program is at stake. In a 4-year program, this amounts to 16 reviews. The impact of such uncertain funding is obvious. Few businesses can operate on a short-term basis, and scientific research specifically requires long-term advance planning.

The present practice is not constitutionally required. Under many programs, funds may be voted to remain available until expended, as is done under long-term contracts in the federal highway program. Some authorizing statutes permit the appropriation of such funds as Congress may from time to time find necessary. There is no requirement for the present practice of specifying dollar amounts in authorizing legislation. The difficulty caused by the existing practice of enacting short-term authorization statutes with dollar limits on federal appropriations creates instability in research work and insecurity among researchers. With such uncertainty, many qualified experts have been reluctant to participate in a new

field. A proposal (H.R. 16729) now before a House-Senate conference committee would permit funding during one year for expenditures for the following year under certain education programs.

The Committee on Federal Legislation of the New York County Lawyers' Association recently recommended long-range funding and stated:

... [it] is not novel. Whenever it has become clear that long-range planning with knowledge that funds are available is indispensable to the effectiveness of a program, methods have been found to achieve this. Any other course is wasteful and amounts to throwing away a large part of the funds spent, because they cannot be effectively used without long-term planning. . . .

Scientists might well join forces with those working in other fields to further the cause of long-term funding.

RICHARD A. GIVENS

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A Matter of Judgment

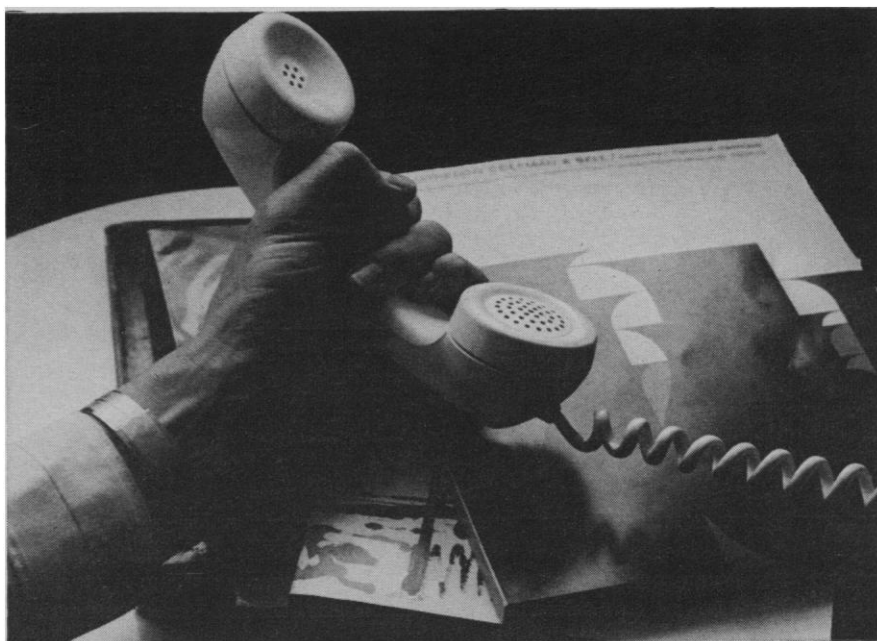
Conservation controversies are disputes in viewpoint. Porter (Letters, 5 July), argues that the proposed mining in Glacier Bay National Monument is desirable because greater benefits would result than would by leaving the Monument inviolate. I would argue the opposite, but for exactly the same reason. The point of disagreement is not one which can be resolved by "objective analysis" of the "facts." These are differences in value and judgment. . . . Most resource allocation problems are not ones of "right" versus "wrong," of conservationists fighting greedy exploiters, but rather they are disputes over what constitutes the best kind of conservation. Certainly scientists can point out the danger of pesticides, but how can they decide the Glacier Bay mining dispute? Does the recent article on coast redwood ecology by Stone and Vasey (12 Jan., p. 157) resolve the Redwood National Park question? I think not.

Criteria for decision-making in conservation controversies (use versus preservation of landscapes) is needed. . . . The search for answers must start with defining the goals, values, and purposes of society. Science does not claim to answer questions of civil rights; is the problem of mining in Glacier Bay National Monument really any different?

TOM VALE

Department of Geography,
University of California, Berkeley

13 SEPTEMBER 1968



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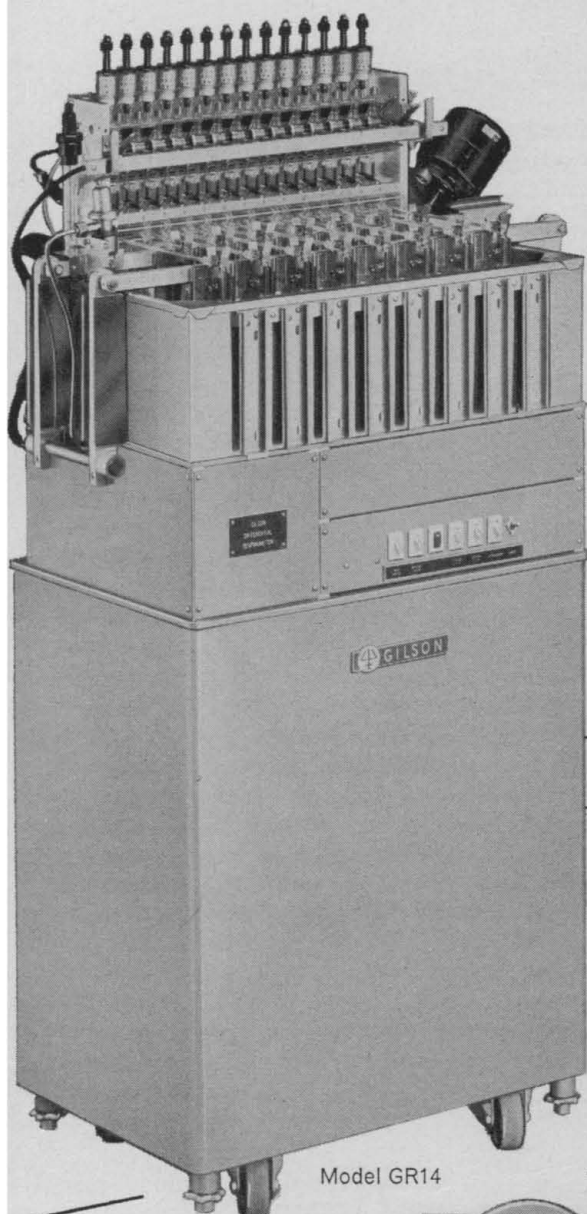
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Financial Problems of the Private Universities

Friendly competition among the private and public universities of this country has fostered innovation and progress. In contrast, the monolithic European system has been slow to meet changing conditions.

Our dual system now seems threatened. Many of the private universities are finding themselves in a financial squeeze that may become crippling. Income has been increasing, but costs have been rising faster. These trends have been analyzed by Provost Bowen of Princeton.*

The major contributor to the financial bind is not general inflation or greater enrollments. The essence of the problem is that cost per student has been increasing at a rate of about 7.5 percent per year. A major factor is faculty salaries, which have been growing at the rate of 5 percent per year. At the same time, the size of classes at private universities has not increased very much, and a growing proportion of the student body has been engaged in graduate studies. At public universities the cost per student has not risen so fast. Greatly increased enrollments have been accompanied by a trend toward larger classes, and the proportion of graduate students has not changed much.

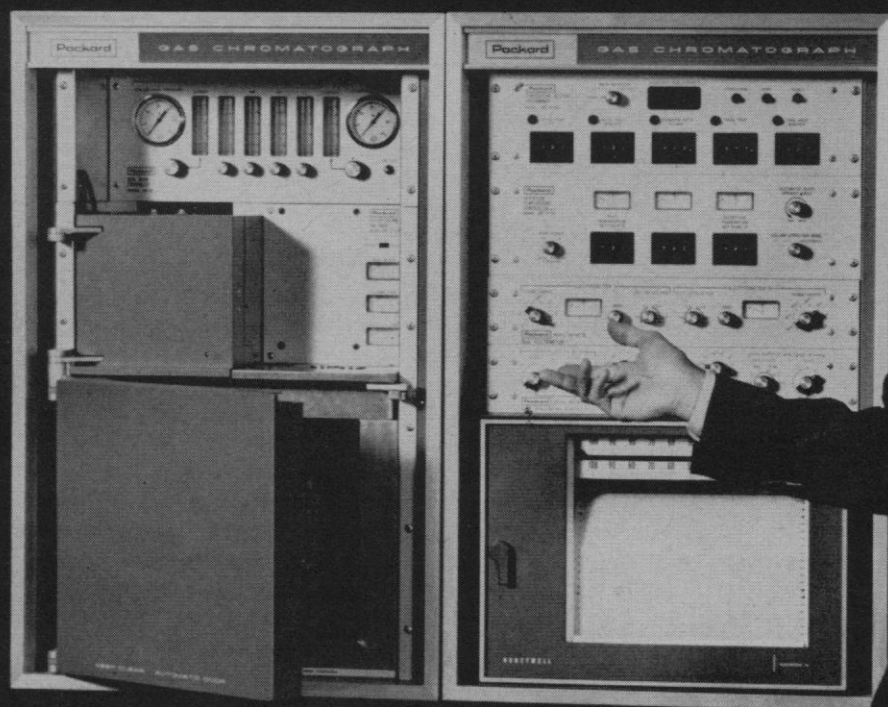
Some of the factors leading to increased costs are common to both types of institutions. For example, the costs of maintaining adequate libraries are advancing at a rate of more than 15 percent per year. Computer facilities, now so important to many studies, are a financial burden. The increasing complexity of fields of scholarship requires that larger staffs be recruited to provide adequate coverage. Looking to the future, Bowen suggested that cost per student will continue to advance at a rate of about 7.5 percent per year and that enrollment will grow by 3.4 percent per year. Thus the costs of operating a typical private university will nearly triple in a decade.

In attempting to increase income correspondingly the private universities face a difficult task. At one time endowment income supplied almost half of their needs. Today only about 10 percent of their funds come from endowments. Prime sources are tuition, annual giving, and the federal government. Private universities have already increased tuitions as much as is feasible, sometimes more. The total cost of attending a private university is more than twice the cost of attending a public one. This is true at a time when the private schools are attempting to democratize their student bodies. Prospects for large increases in annual giving are not good. An important factor has been a change in policy by some of the foundations, notably the Ford Foundation. Private giving is no longer growing at the rate of former years, and a significant part of it is being channeled to public universities. In principle, the government could and should help the private universities through mechanisms that would not destroy their independence. In practice, the government tends to behave capriciously while harassing its grantees with bureaucratic regulations.

If the current financial squeeze intensifies, as predicted, the private universities will cease to compete successfully with public institutions. Should this occur, higher education will lose much of its vitality and the nation will suffer accordingly.—PHILIP H. ABELSON

*W. G. Bowen, *The Economics of the Major Private Universities* (Carnegie Commission on Higher Education, Berkeley, Calif., 1968)

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