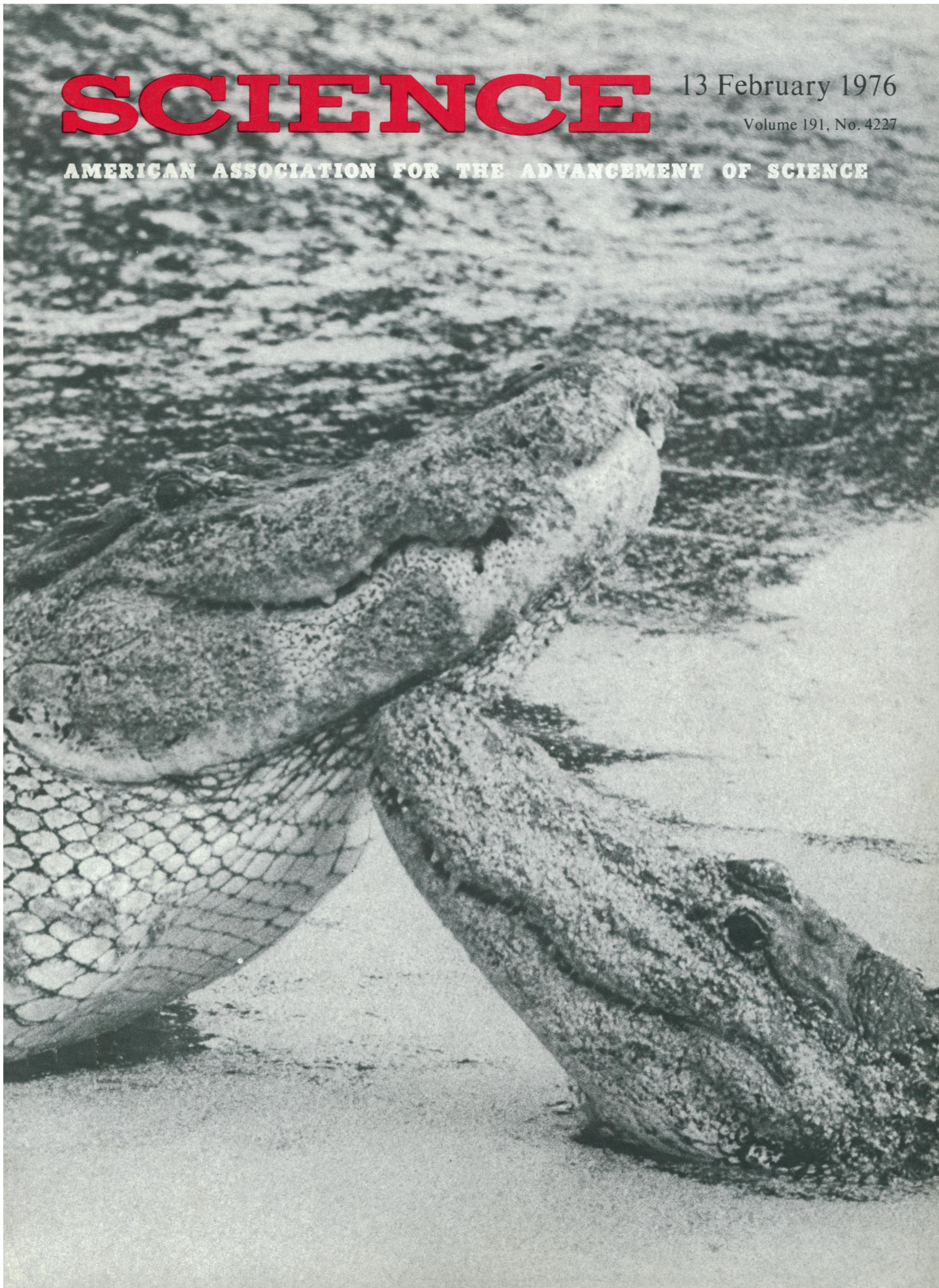


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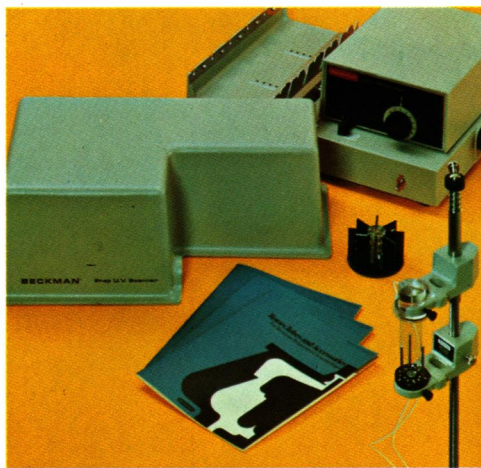
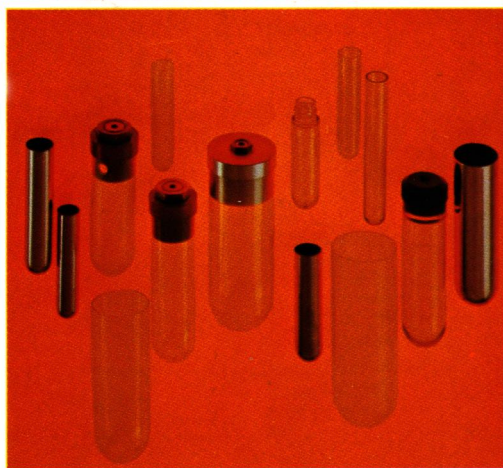
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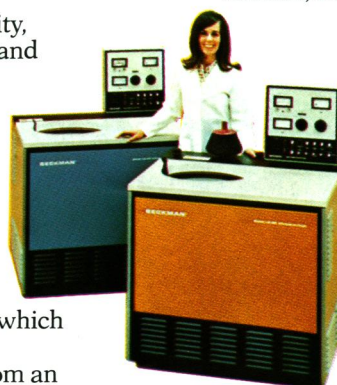
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COVER

Male American alligator (*Alligator mississippiensis*) bellows and is approached and contacted by a female (right). In the spring, bellowing and courtship are early morning aquatic activities that precede movements onto land. The amphibious behavior of alligators is mediated by an endogenous circadian rhythm cued by light. See page 575. [Jeffrey W. Lang, University of Minnesota, Minneapolis]



Is an HP calculator an engineering work of art?

It depends on how you look at it. Stand outside, and you see a collection of parts, a tool — full of utility, but not much more.

Get inside — beyond the keys to the hierarchy of concepts that underlies them, and you sense the harmony of art.

Intuitively right ideas.

You discover that intermediate answers tend to appear automatically, as if on cue. An HP designer saw what could be gained by combining RPN with a 4-register stack.

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You discover that all functions are directly accessible from the keyboard. You don't have to memorize a secret formula to get to a conversion constant.

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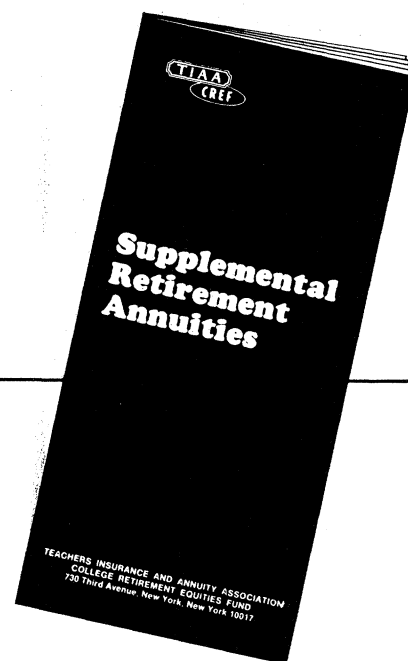
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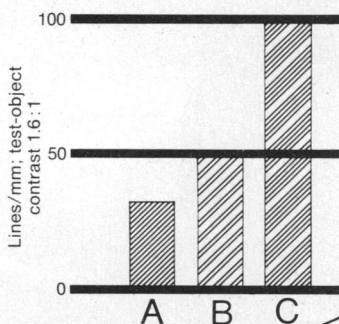
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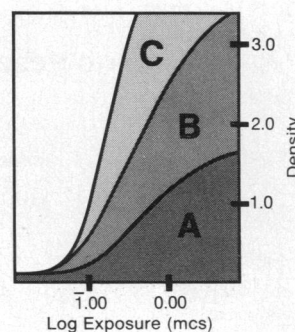
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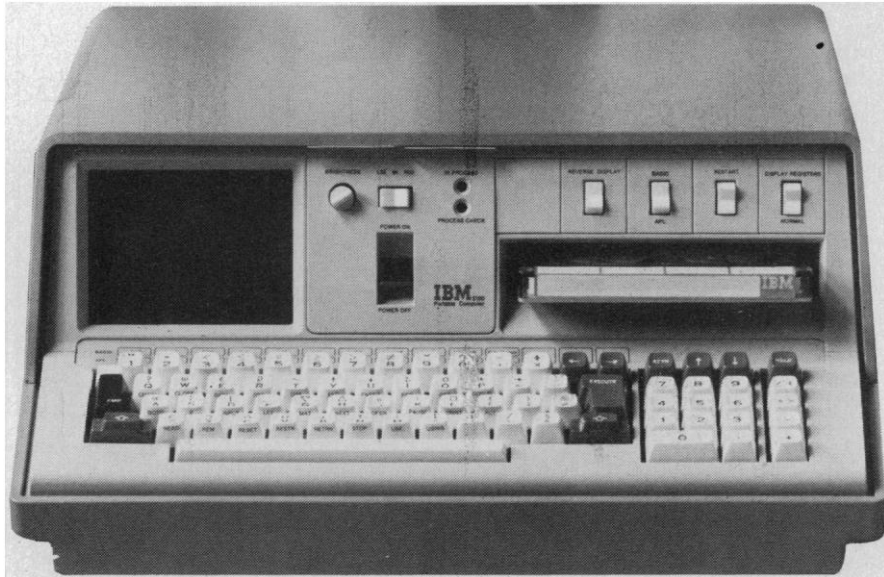
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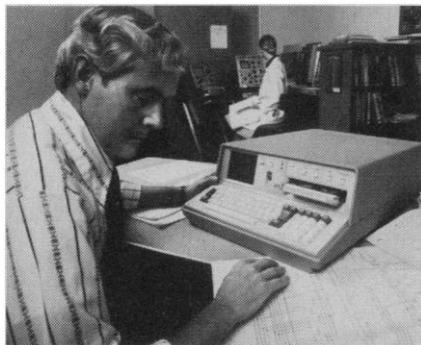
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The new IBM 5100 is a sophisticated problem-solving aid incorporating the very latest in semiconductor technology.

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The 5100 goes to work wherever you need it to help solve the most complicated problems.

acter lines. In addition, the 5100 display screen has a scrolling capability that allows you to move information up or down for easy editing.

The 5100 uses a tape data cartridge which holds more information than the cassettes used in other small computers.

Still another advantage of the 5100 is its large main storage capacity, up to 64K bytes.

The 5100 also features an optional 80 character per second bi-directional printer, an auxiliary tape unit that reads up to 2850 characters per second and an optional communications adapter that turns the 5100 into a terminal capable of transmitting information to a larger processor.

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The 5100 is available with three language options: BASIC, APL or both. BASIC is a generally well known, easy-to-use language using English-like commands to solve engineering and scientific problems.

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Just flip a switch to go from BASIC to APL.

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- Transformation, alters columns in matrices
- Tally
- Moment
- Correlation
- t-Test
- Chi-square Test
- Survival Rate
- Probit Analysis

Time Series Analysis

- Moving Average
- Seasonal Analysis
- Cyclical Analysis
- Autocovariance and Autocorrelation
- Triple Exponential Smoothing
- Crosscovariance and Crosscorrelation

Regression and Design Analysis

- Simple Regression
- Multiple Regression
- Polynomial Regression
- Stepwise Regression
- One-way analysis of variance
- Factorial Design

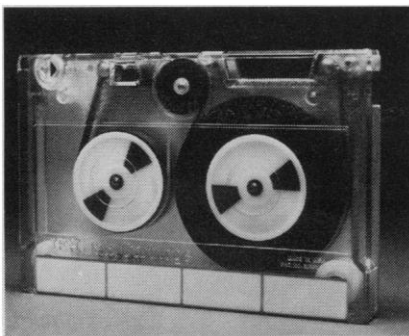
Multivariate Analysis

- Discriminant Analysis
- Canonical Correlation
- Factor Analysis

Non-Parametric Statistics

- Kendall Rank Correlation
- Kendall Coefficient of Concordance
- Sign Test
- Wilcoxon Matched Pairs Signed Rank Test
- Mann-Whitney U-Test
- Friedman Two-way Analysis of Variance
- Cochran Q-Test
- Biserial Correlation
- Point Biserial Correlation
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- Matrix Eigenproblem
- Eigenvalues and Eigenvectors
- Integration
- Differentiation
- Interpolation, Approximation and Smoothing
- Zeroes and Extrema of Functions
- Ordinary Differential Equations
- Finite Fourier Transform
- Special Functions
- Linear Programming

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LETTERS

Ranking Materials Departments

The article by Deborah Shapley (News and Comment, 9 Jan., p. 53) on the fairness of grant awards to, and ranking of, materials science departments raises some important and interesting issues, but misses certain major nuances in the data. There can be no issue regarding the propriety and value of Kuhlmann-Wilsdorf's inquiry and protest regarding alleged improper management within a section of the National Science Foundation's Division of Materials Research. Surely there are no members of the science community who would suggest that honest disagreements with a bureaucracy not be aired. I believe that Kuhlmann-Wilsdorf has performed a courageous and invaluable service to the materials community by helping to raise fundamental questions. Whether or not her allegations prove to be correct is another matter on which some further light will no doubt be shed. However, given the fact that most of the data on awarding of NSF grants are not released to the public, definite conclusions will elude us.

On the question of departmental rankings, as chairman of the National Academy of Sciences' Committee on the Survey of Materials Science and Engineering Panel on the Universities, I regret Shapley's rather casual treatment of its data. The matter of "ranking" of universities is an extremely subtle matter. The NAS study was a 3-year effort. The analyses were based on 5- and 10-year averages of data collected explicitly for the study by means of extensive questionnaires. Such a published report surely has a standing as a reference work and should be reported on in depth, not as a column in a table.

The Academy study panel utilized the methodology of Elton and Rodgers to obtain its rankings; Shapley's article claims that Stein used the same method. However, since his study is not published, one can only presume he used incomplete or imprecisely defined data, which can only add to confusion.

The Academy's study has to be painstakingly precise in defining what was included as a "materials science department." Moreover, the Academy panel was at some pains not to imply that "quality" of departments could be precisely measured. The term "strength" was used instead of quality. Furthermore, while Shapley showed considerable enterprise in obtaining the list of departments, I believe she went beyond the precision possible with the data. The data could probably be interpreted as ranking the top ten universities into three groups. MIT and Penn State

are far "stronger" than the next set, which would include (in alphabetical order) Case Western Reserve, Illinois, Northwestern, Ohio State, and RPI; they would be marginally ahead of the third set, California (Berkeley), Lehigh, and Stanford.

The quantification of quality is an extremely difficult task at best, worthy of as careful and meticulous a study as the most subtle semiconductor phenomenon. The NAS study is based on good data, careful analysis, and collective judgment, and can serve as a standard to be improved upon, if possible, but not equated to ad hoc comments which sometimes provide ammunition to those forces which resist any attempts at accountability.

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Job Safety

The labor movement, like other institutions in our society (including science), has been increasingly criticized for failing to solve the urgent problems of our time. Much has been written about the esoteric and narrow nature of science, especially in the area of job safety. Labor unions also have been criticized for not protecting the health and safety of their members; but we, as laymen, find ourselves at a severe disadvantage. We have occasionally contributed to the criticism of science and of some scientists whose denials and distortions have allowed serious health problems to continue on the job (see J. T. Edsall, 16 May 1975, p. 687). But we also realize that such individuals are few (and are, we hope, becoming fewer) and that science and scientists are important allies of working people as they battle against disease and death. We have been keenly aware of this in our trade, faced as we are with toxic chemicals, solvents, chromates, exotic new chemicals and paints, silica and sand blasting, asbestos, vinyl chloride, and so forth.

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13 FEBRUARY 1976

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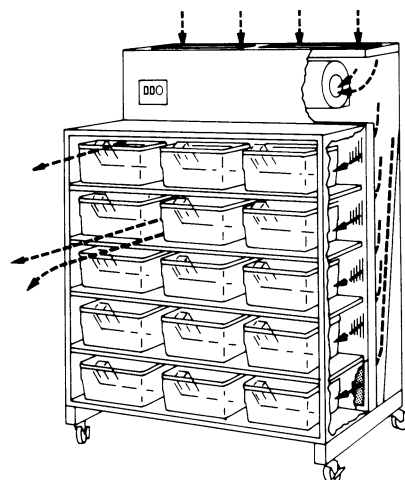


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lic, especially to your wide circle of readers, is important. Things began to happen. After being told that nothing could be done, we now have been informed by one company that "after extensive research," they "have developed an alternate formula, and within a month all spackle production will be free of asbestos." Another company expects "to eliminate asbestos fibers entirely in all [its] products by the end of this year." A third company which has long produced the material our men only knew as a "taping compound" has informed us that they "are adding a caution statement to [their] labels."

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S. FRANK RAFTERY
International Brotherhood of Painters and Allied Trades, 1750 New York Avenue, NW, Washington, D.C. 20006

Federal R & D Management

Raymond L. Bisplinghoff addresses a number of very timely questions in his editorial on federal R & D management (12 Dec. 1975, p. 1045). But in his call for new policies, he fails to ask the most critical question of all: Why should the federal government do R & D in the domestic sector at all? In the military and space sectors, it seems reasonable that federal agencies should at least do sufficient R & D to keep their industrial suppliers honest. But in the domestic sector, there is little evidence that significant R & D tasks are being left undone, and competition rewards effort quite adequately. All the factors that Bisplinghoff cites do indeed prevent federally funded R & D from being effective, but there is little evidence that its absence is being felt. The logical conclusion is to stop trying to provide expensive and unneeded services.

Bisplinghoff is perceptive in his recognition of the poor record of the private companies serving largely as purveyors of R & D to the federal government. Apart from their commercial shortcomings, these companies have a poor record as advisers to the government. This means that the government has gotten poor value for its money. But the impact of this inept advice is unfortunately far greater than that. In determining policy, the advice received from these politically pure but commercially negligible companies is weighed

against the advice from companies that can actually deliver. These companies tend to be large, competent, and politically unpopular. As a result, the government often has to choose between good news from a pure source and the facts. The facts usually lose. No one can blame the bureaucrats involved. They are generally neither stupid nor venal. But who wants to be crucified for favoring Standard Oil, just because they were telling the truth? Even the advice business badly needs reorganization. And it's going to be difficult, because the best advice often comes from politically unacceptable sources.

THOMAS GULDMAN
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ERDA Research Programs

With the peer review process under intensive scrutiny, consider the comforting circumstances surrounding the research program at the Lawrence Berkeley Laboratory (LBL). With an operating budget in fiscal year 1975 at a level equal to that for research at a large university (approximately \$42 million), increased by 13 percent over fiscal year 1974, with additional expenditures of about \$4 million for equipment, LBL operates without the travail of having to generate about 1000 proposals each year, most subject to the long uncertain process of peer review. Only the wild grasses, the blue elderberry, the black-tailed deer, and the California poppies glowing golden in the sun (*I*) are around to cast a critical eye on LBL activities.

Closed systems such as those at LBL and at other research labs inherited by the Energy Research and Development Administration (ERDA) from the Atomic Energy Commission deserve more scrutiny and evaluation than they are presently getting. At the ERDA University Conference on 3 and 4 November in Washington, D.C., I and others, while grateful for ERDA's initiative in organizing the conference, shared the feeling that ERDA's capability for future support of the nation's colleges and universities is being preempted to a significant extent by the generous institutional support of their in-house research programs.

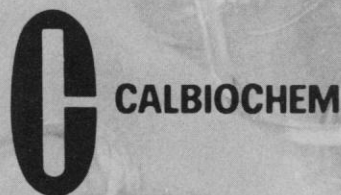
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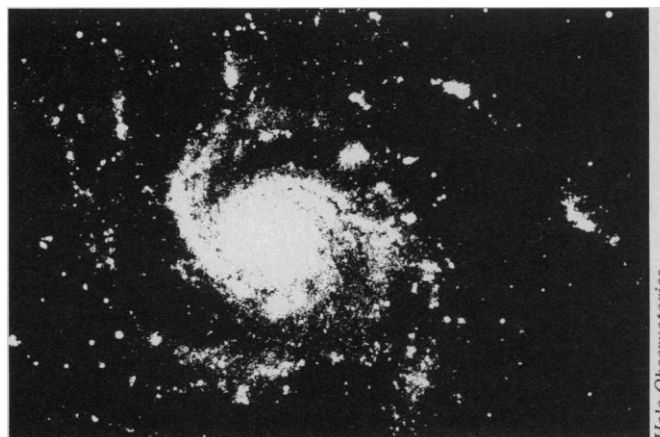
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Federal Regulations: Make the Punishment Fit the Crime

The federal government seeks to achieve a multitude of objectives. Two that have been of considerable concern, particularly to the academic and scientific community, are (i) advancement of scientific research and the ensuing technological developments, and (ii) achievement of equal opportunity.

Solicitous of the welfare and will of the people, the federal government has a stake in the advancement of research, much of which leads to improved health and well-being. The elimination of poliomyelitis within the last two decades is an example par excellence. Without continued federal support for research, we would enjoy fewer solutions to our major problems in health and energy, as well as in the social and economic domains.

The federal government also has a stake in equality. Citizens should not be discriminated against because of their race, color, religion, sex, national origin, or handicapped status; thus, in the ideal university these factors will not determine whether a citizen is admitted for study, given financial aid, employed, or allowed to do research. Achievement of equality is therefore a high-priority national objective, as is the advancement of research.

The federal government makes receipt of its funds for scientific research contingent on satisfactory compliance with the affirmative action regulations designed to achieve equal opportunity. Receipt of research funds is also contingent on compliance with other regulations, such as those pertaining to research on human or animal subjects, or to occupational safety and health. Even non-compliance with the Buckley Amendment, which broadens students' access to their educational records, leads to federal threats to remove certain funds from institutions.


Setting aside the issue of whether the government should be regulating everything from birth control to rat control, and whether the regulations affecting universities should be improved or clarified, the question addressed here is: Why piggyback the government regulations onto the support of scientific research? When a university or other institution makes a scientific advance, all citizens benefit, but no individual or institution benefits exclusively. Thus, if funds were cut off from the top 10 or 100 universities for failure to comply with, for example, affirmative action regulations, society would be the big loser. Removal of research support as a punishment for alleged noncompliance with statutes that are at times not even marginally related to scientific objectives is an irrelevant and undeservedly harmful punishment—harmful not only to a particular investigator and institution, but also to the countless beneficiaries of that institution's research. In short, the current system subverts one national objective, advancement of science and technology, in an effort to achieve other national objectives, such as equality.

The objective of equality appeals to us all; so do safe working conditions and protection of the rights and privacy of students. The problem is implementation. Government and university officials would do well to consider how these objectives, which have given rise to endless regulations, could be accomplished without endangering scientific goals. It has been suggested,* for example, that the affirmative action objective would be enhanced by a program of early identification and training of talented women and members of minority groups. This strategy would serve the goal of equality far better than countless difficult, possibly even unenforceable, regulations. Another strategy: instead of regulations, why not some system of incentives? Why not "the carrot instead of the stick"?†

If the regulations are here to stay, the government should consider alternative ways to enforce them, which do not conflict so drastically with the advancement of science. For example, why not tie the regulations to the Guaranteed Student Loan Program, or to the accreditation process, or even—if it came to that—to the university's tax-exempt status? Why not fine universities that fail to comply? Better yet, how about throwing the university's officers in the pokey along with other lawbreaking rascals!—ELIZABETH F. LOFTUS, *American Council on Education Fellow, Harvard University, Cambridge, Massachusetts 02138*

*F. P. Thieme, *Science*, 19 December 1975.

†P. H. Abelson, *Science*, 17 October 1975.



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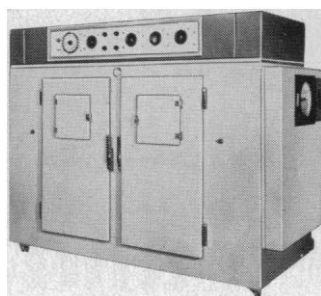
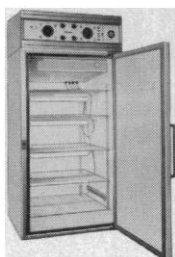
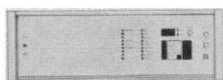
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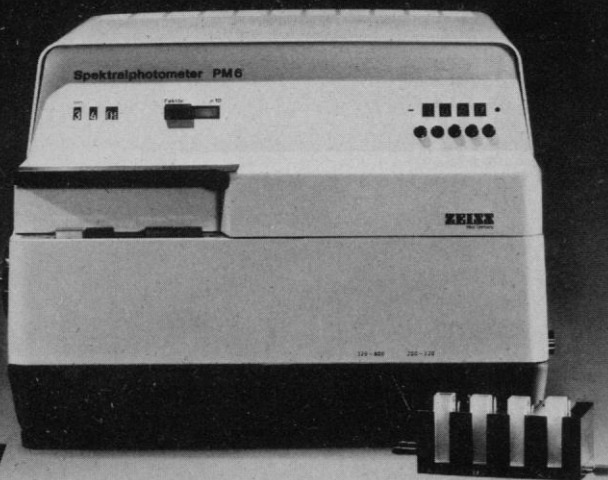


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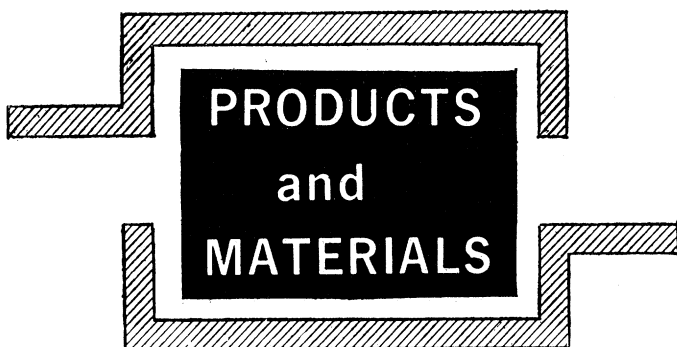
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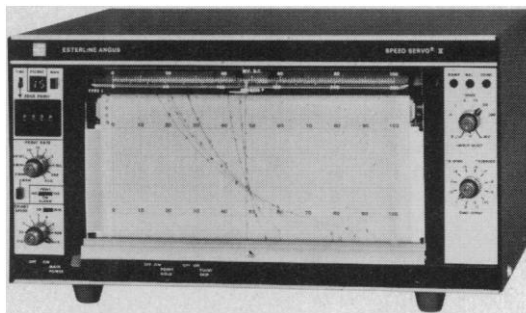
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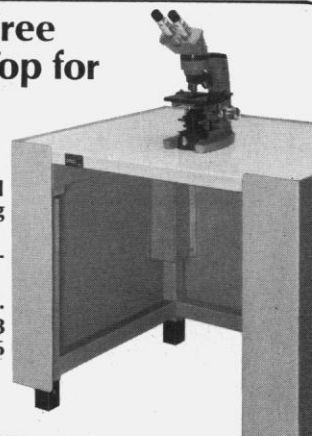
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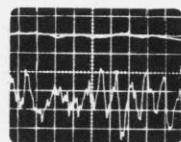
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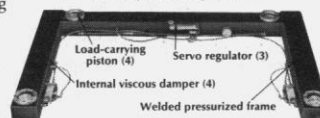


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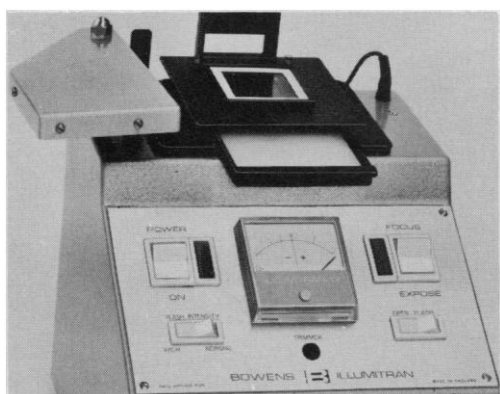
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D. S. Parsons, Ed. Clarendon (Oxford University Press), New New York, 1975. x, 206 pp., illus. \$16.50.

Biology: Food and People. The Economic Importance of Biology. Robert Barrass. St. Martin, New York, 1975. x, 246 pp., illus. \$13.95.

Child Alive! Roger Lewin, Ed. Anchor/Doubleday, Garden City, N.Y., 1975. xii, 228 pp., illus. Paper, \$2.95.

Child Study and Observation Guide. Gene R. Medinnus. Wiley, New York, 1976. viii, 184 pp., illus. Paper, \$5.95.

La Chimie Electronique du Systeme Nerveux. Andrée Goudot-Perrot. Vigot Frères, Paris, 1975. 206 pp., illus. Paper, 39 F.

DNA. The Key to Life. Gary Parker, W. Ann Reynolds, and Rex Reynolds. Educational Methods, Chicago, ed. 2, 1975. viii, 152 pp., illus. Paper, \$4.45. Programed Biology Series.

The Dynamic Meteorology of the Stratosphere and Mesosphere. James R. Holton. American Meteorological Society, Boston, 1975. viii, 218 pp., illus. \$30; to members, \$20. *Meteorological Monographs*, vol. 15, No. 37, Aug. 1975.

Elastic Constants and Their Measurement. Edward Schreiber, Orson L. Anderson, and Naohiro Soga. McGraw-Hill, New York, 1974. xii, 196 pp., illus. \$22.50.

Elastodynamics. Vol. 2, Linear Theory. A. Cemal Eringen and Erdoğan S. Suhubi. Academic Press, New York, 1975. xiv + pp. 343-1004, illus. \$65.

The Environment of Early Man in the British Isles. John G. Evans. University of California Press, Berkeley, 1975. xvi, 216 pp., illus. \$12.95.

Environmental Data Handling. George B. Heaslip. Wiley-Interscience, New York, 1975. xiv, 204 pp., illus. \$19.95. Environmental Science and Technology.

The Exciplex. Proceedings of a meeting, London, Ontario, Canada, May 1974. M. Gordon and W. R. Ware, Eds. Academic Press, New York, 1975. xii, 372 pp., illus. \$17.50.

Fibre Bundles. Dale Husemoller. Springer-Verlag, New York, ed. 2, 1975. xvi, 328 pp., illus. \$16.80. Graduate Texts in Mathematics 20.

Finite Mathematics. An Introduction. Bodh R. Gulati. Harper and Row, New York, 1975. x, 390 pp., illus. \$12.95.

Fluid Environment of the Brain. Proceedings of a symposium, Salsbury Cove, Maine, Sept. 1974. Helen F. Cserr, Joseph D. Fenstermacher, and Vladimir Fencel, Eds. Academic Press, New York, 1975. xii, 290 pp., illus. \$16.

The Flying Circus of Physics. Jearl Walker. Wiley, New York, 1975. xvi, 224 pp., illus. Paper, \$7.50.

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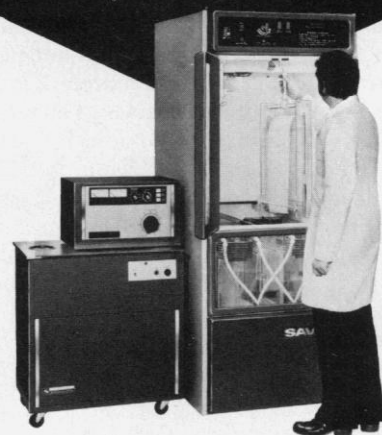
The Forest Service. A Study in Public Land Management. Glen O. Robinson. Published for Resources for the Future by Johns Hopkins University Press, Baltimore, 1975. xviii, 338 pp. Cloth, \$16.95; paper, \$4.95.

Genetics and Psychopharmacology. J. Mendlewicz, Ed. Karger, Basel, 1975. viii, 132 pp. \$25.50. Modern Problems of Pharmacopsychiatry, vol. 10.

Hallucinations. Behavior, Experience, and Theory. R. K. Siegel and L. J. West, Eds. Wiley, New York, 1975. xiv, 322 pp. + plates. \$25. A Wiley Biomedical Publication.

Handbook of Learning and Cognitive Processes. Vol. 1, Introduction to Concepts and Issues.

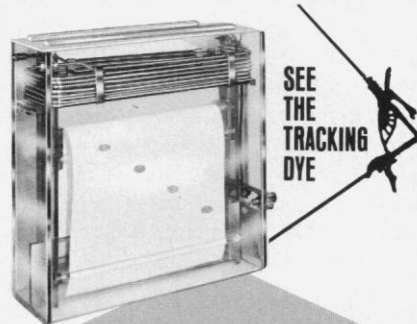
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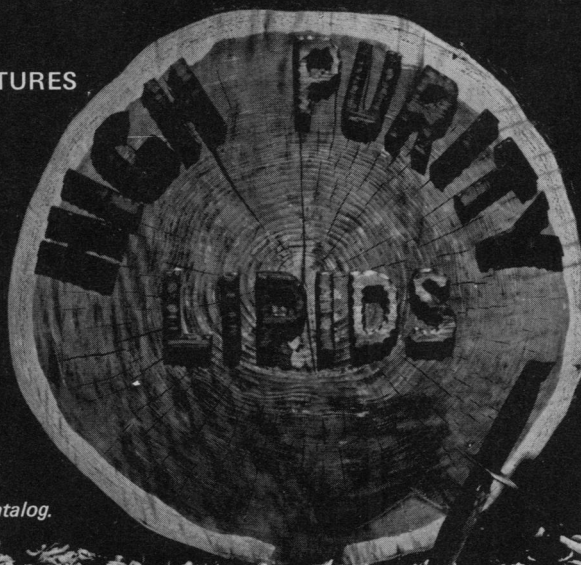
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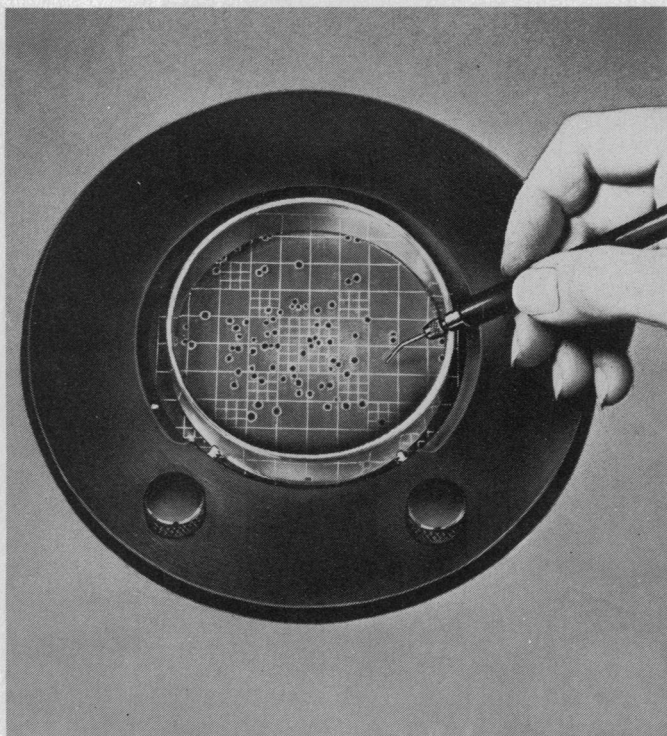


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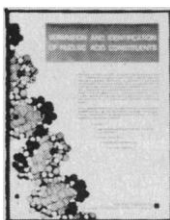
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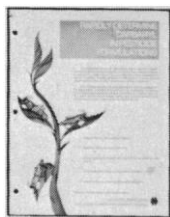
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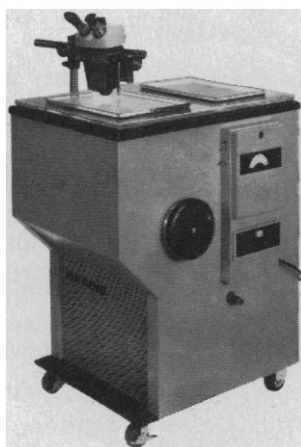
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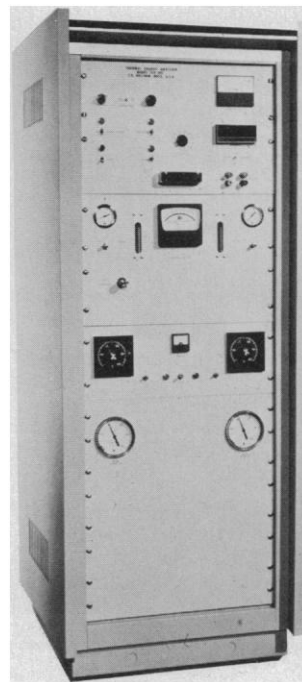
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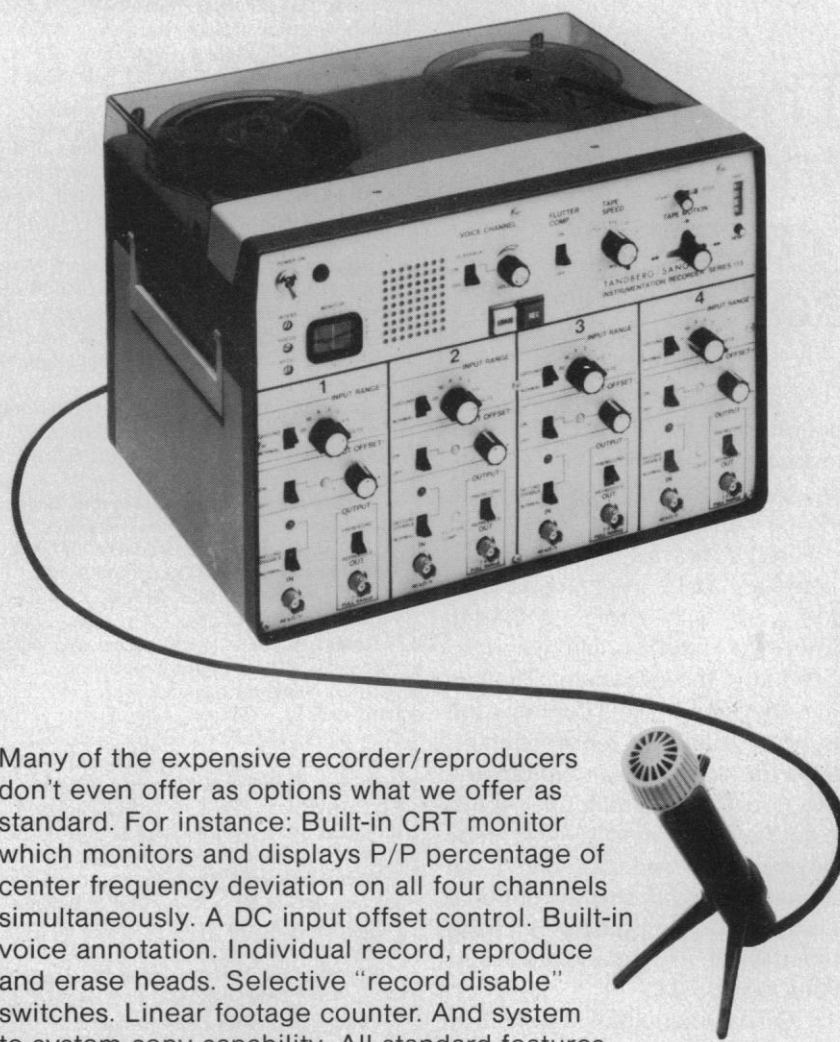
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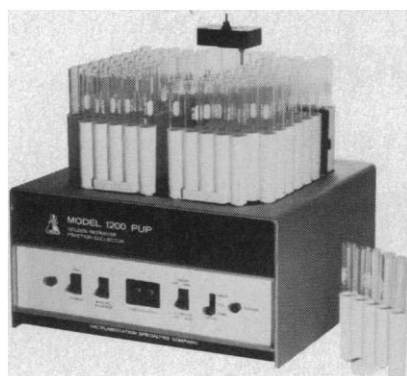
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