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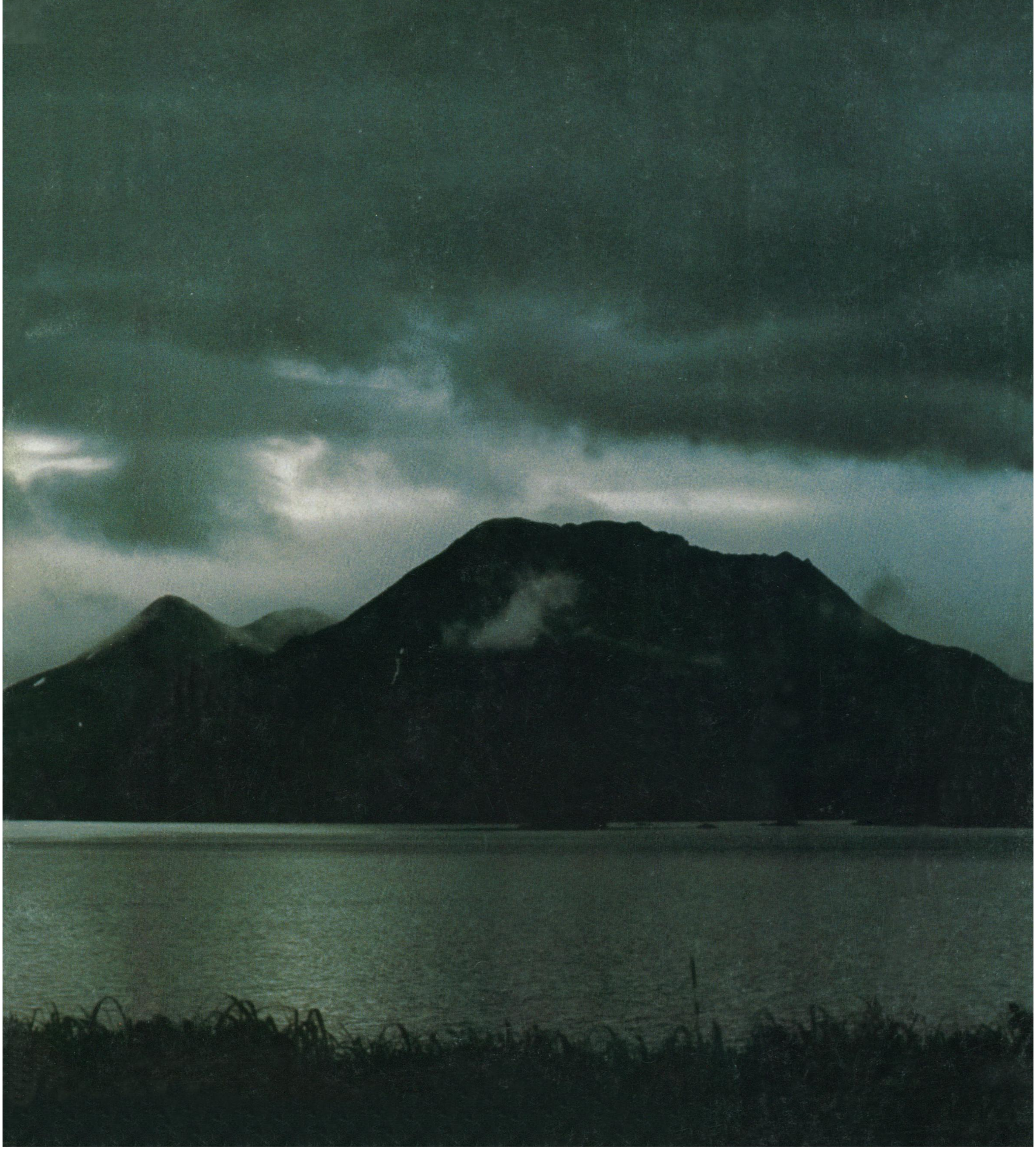


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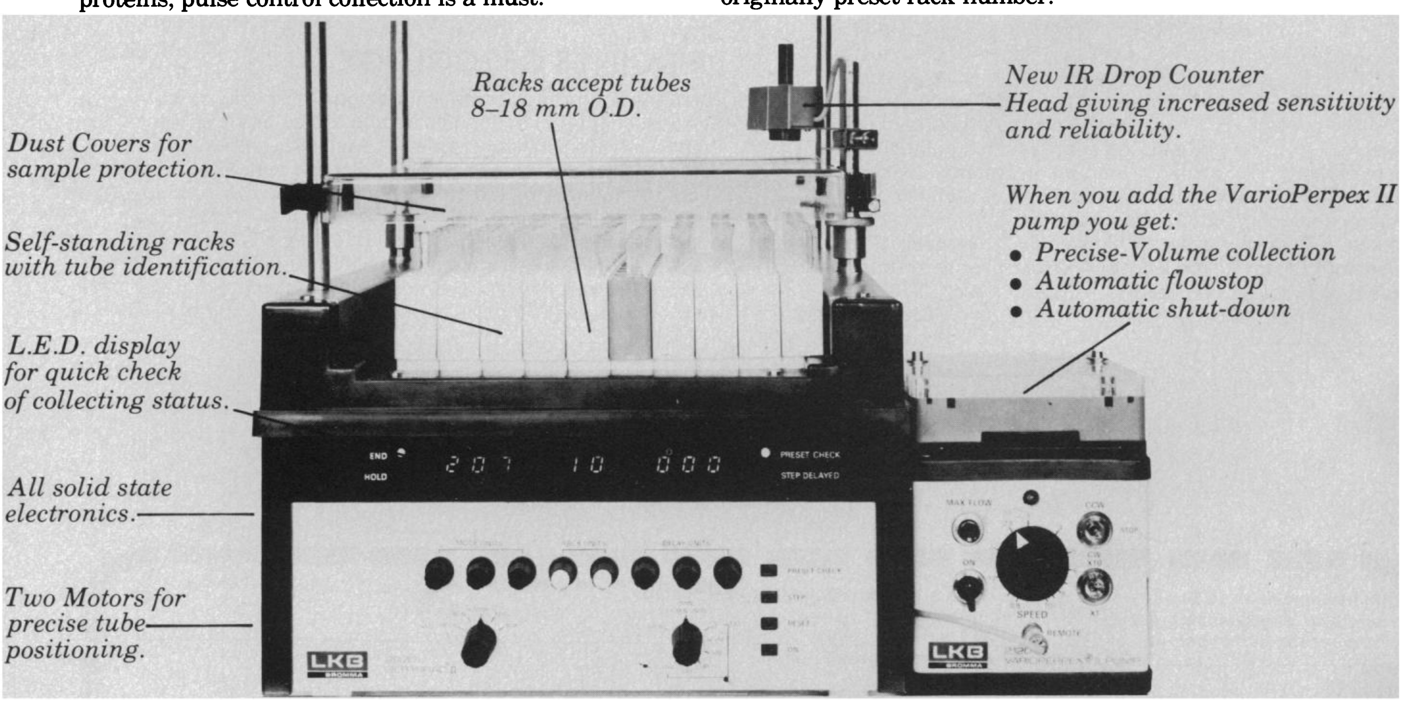


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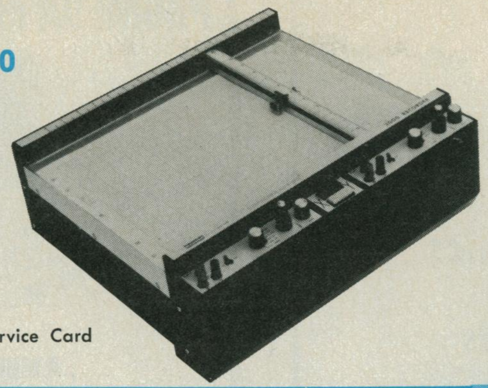

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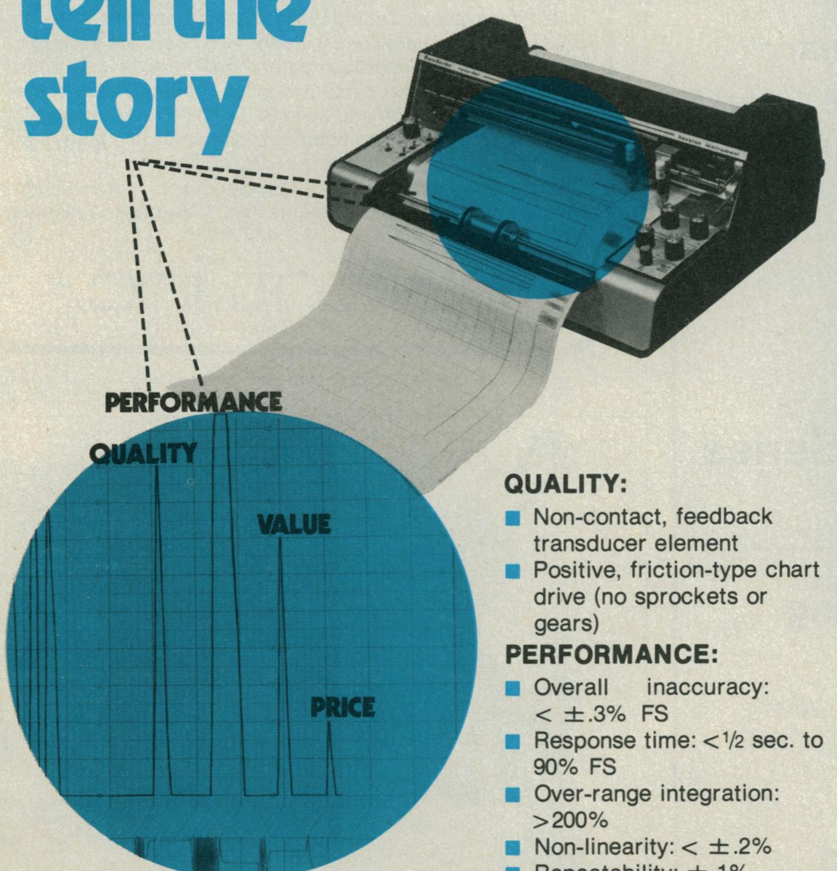


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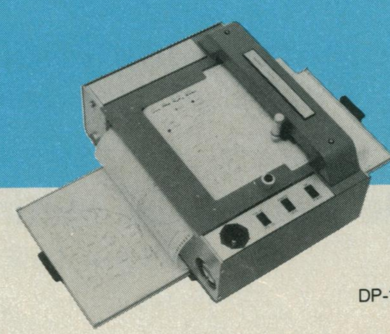

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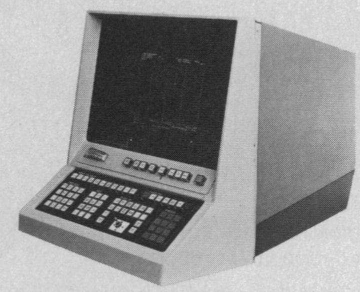

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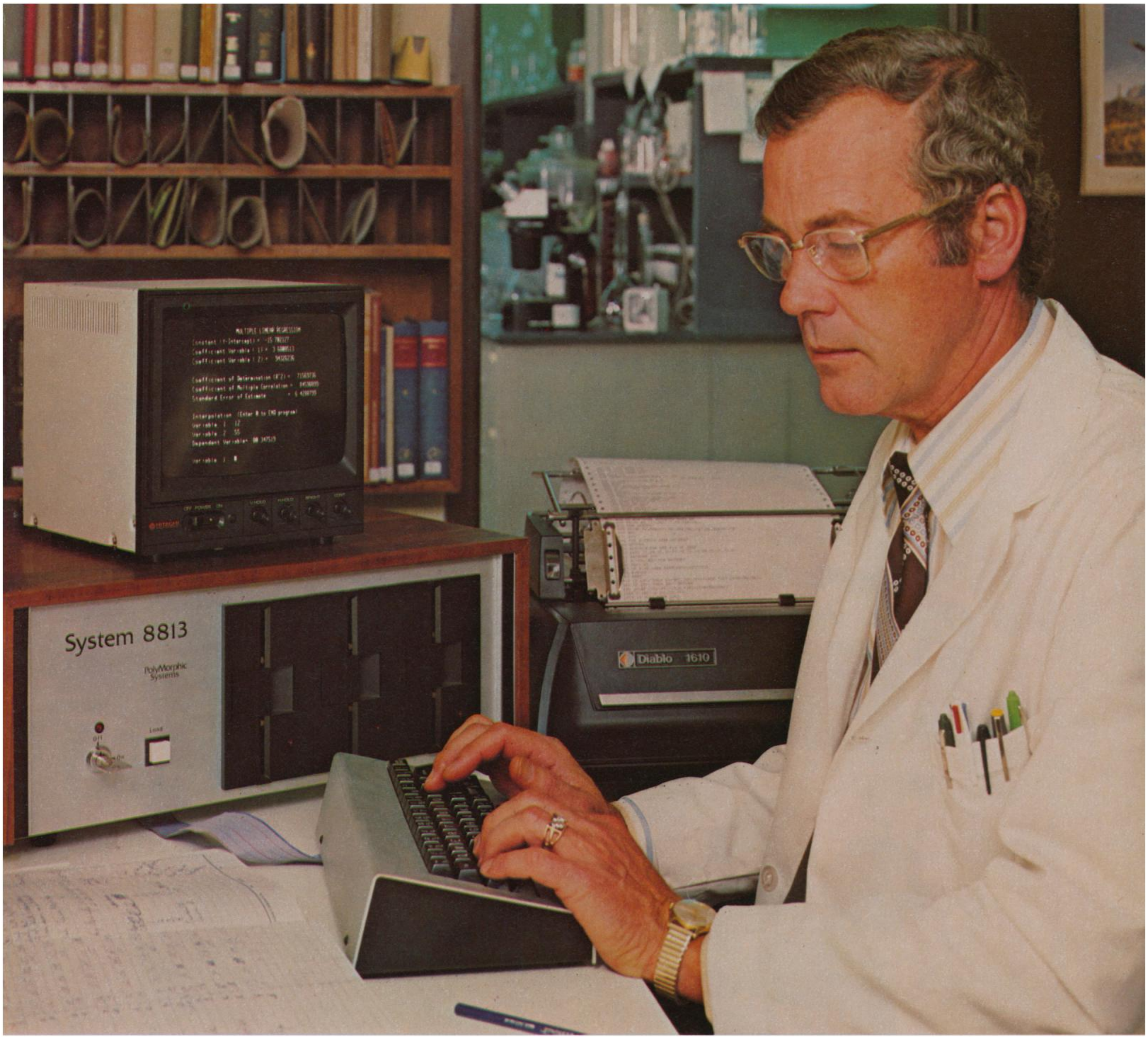


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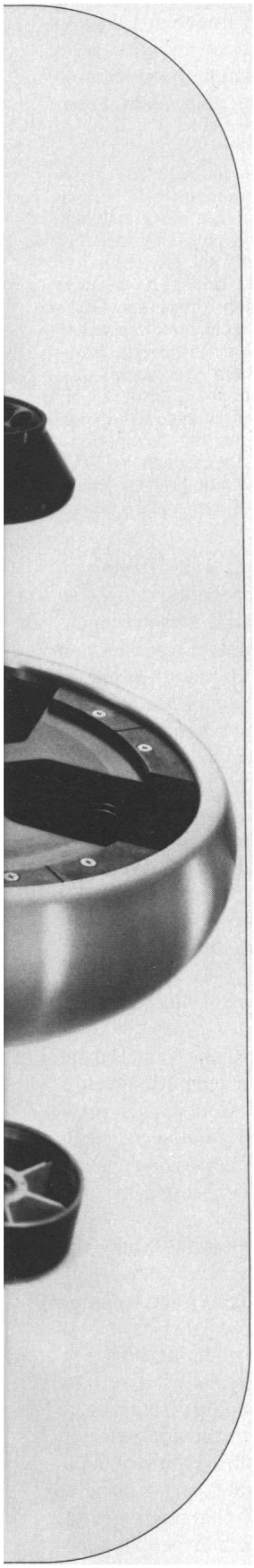

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**LETTERS**

## Will Gutenberg Survive?

In partial response to Garrett Hardin's editorial "Will Xerox kill Gutenberg?" (2 Dec. 1977, p. 883), allow me to quote an old document that I have just discovered in the belongings of my great-great grandfather. I translated the document from the original Armenian, and it reads as follows:

> Father Kevork came to bless our house today. After the traditional rituals we sat down to chat. Father Kevork was greatly disturbed and incensed [no pun intended]. For some years now, it seems, the price of parchment has been hitting the ceiling. At the same time, taxes levied by Shah-Abbas (may God's curse be on him) have reached intolerable levels. To complicate matters further, the transportation routes between Pergamum and Etchmiadzin are not safe at all. Also, our beloved lazulite is becoming scarce, and no other blue could replace it in our illuminations. And the final blow has been dealt by some barbarian from Germania who prints so-called books, and these books are much cheaper than manuscripts.

Seriously, the point I am trying to make is that we are probably witnessing the beginning of book obsolescence. Xeroxing, computer-linked reproduction systems, microfilms, computer-based information retrieval systems, and so forth have begun to replace books. And in about a century or so, we will not miss books any more than we miss incunabula today. In short, in dealing with the "book crisis," we need, among other things, some historical perspective and a progressive kind of common sense.

JOHN L. GUERIGUIAN
*Department of Pharmacology, School of Medicine, University of Minnesota, Duluth 55812*

Xerox won't kill Gutenberg, as Hardin predicts, but computer memory systems may. The Library of Congress is planning to close its card catalog by 1980, relying on a computer cataloging system instead. Can other "hard copy" be long in following?

The economics of book publishing are unarguable, but if we reverse our perspective on Hardin's figures and look only at the author and publisher royalties, the cost per page of scientific books is reduced to 1.4 cents. If the user were to pay for printing (presumably from a local terminal with access to the computer of the publisher or of a library), it would be cheaper to buy a book than to make a copy. The practice of charging more to libraries for journals could be extended to books as well. Individuals might buy computer access to books and be charged through their telephone company, as they are now charged for telegrams.

Such a system would provide wider and more rapid access to scholarly work; we may hope that data printers capable of fine typography will be available to those of us who like a well-designed book.

LORING INGRAHAM
*Department of Psychology, Catholic University of America, Washington, D.C. 20064*

The threat of impending bibliocide described by Hardin clearly is another example of the "tragedy of the commons" (*1*), although it is not identified as such. Here, the commons is knowledge, and a balance between the need for access to knowledge and the need for incentives to discover and to publish new knowledge is critical. According to Hardin (*1*), the remedy for misuse of a commons consists of "mutual coercion mutually agreed upon" which results in denying access to the resource or in regulating its use, such as a societal decision that the resource shall not be a commons. Denial of access might be achieved by requiring that all copyrighted materials be printed on paper impregnated with a fluorescent additive that interferes with xerographic copying; such a technique is used by our intelligence agencies. Regulation of use might involve the issuing of duplication licenses that would be revocable in cases of misuse, just as liquor licenses are. But, should these measures prove successful, they would deprive us of much of the convenience and currency afforded by xerography and thereby impede the dissemination of knowledge. The desired balance might be effected by instituting a tax on xerographic copying, with the revenue distributed to publishers. Concurrently, a tax would increase the total cost of such copying, thus restoring books to the competitive market while preserving the advantages of xerography.

TAD E. REYNALES
*Department of Biological Sciences, University of California, Santa Barbara 93106*

**References**

1. G. Hardin, *Science* **162**, 1243 (1968).

The editorial "Will Xerox kill Gutenberg?" calls attention to the increasing disparity between the economics of the printing press and xerographic copying for small runs.

The National Technical Information Service (NTIS), which announces annually about twice as many new titles as the entire U.S. book industry, sells only a few copies of many of these titles. In spite of the low volume, the development of automated xerographic equipment and order processing procedures for the NTIS service makes it possible to sell a single copy, printed on demand, for about $8 (average).

Such pioneering has made it possible, for the first time, to have easy access at low costs to limited interest publications. Visitors to NTIS concerned with the difficulties of publishing scholarly monographs have, in fact, judged its system to be a solution to this increasingly important problem.

NTIS will announce shortly its Journal Article Copy Service, which includes royalty payments to the creators of the original printed copy. In this case, the coupling of telecommunications, computers, and xerography makes it possible to add, at low cost, to the flexibility and service rendered by the existing publishers.

I suggest that the institutional adaptations to prevent bibliocide have already begun, and the prognosis is very favorable.

WILLIAM T. KNOX
*National Technical Information Service, U.S. Department of Commerce, Washington, D.C. 20004*

A simple solution exists to Hardin's dilemma concerning the illegal copying of books: printing houses could begin to use blue and green inks that are not reproduced well by current copying machines. (Of course, new machines may be developed that *will* copy these colors inexpensively.)

ERIC R. PIANKA
*Department of Zoology, University of Texas, Austin 78712*

Why don't book publishers make xerographic copies of their books available, along with hardbound and paperback editions?

M. B. KIRKHAM
*Department of Agronomy, Oklahoma State University, Stillwater 74074*

The idea that xerography can displace conventional printing techniques because it is better or cheaper is completely wrong, given large enough quantities. The printed *World Almanac* costs, at retail, only one-third cent per page, and no xerographed copy is as easy to read. An energy analysis would, I think, show that xerography is intrinsically more expensive than conventional printing.

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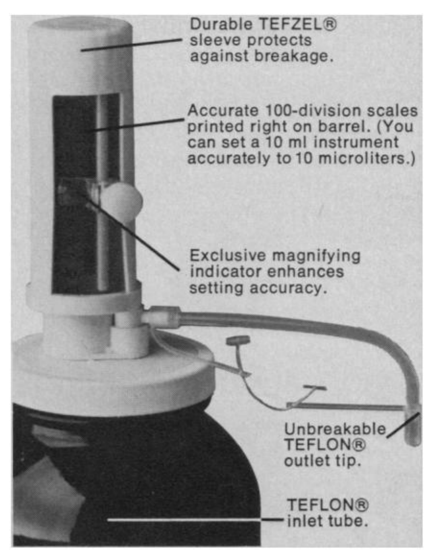


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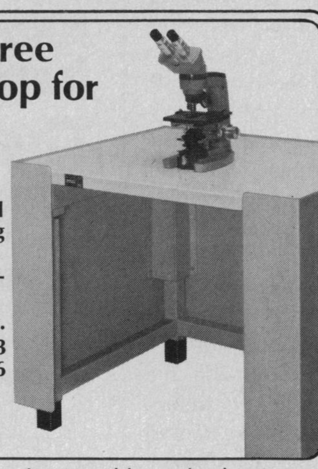

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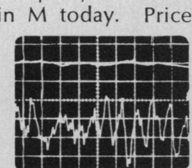


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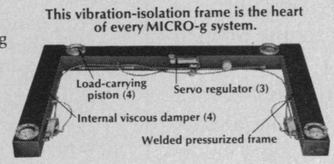


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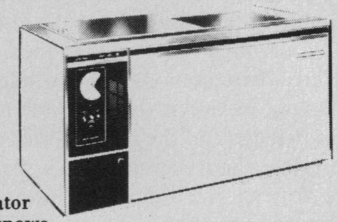

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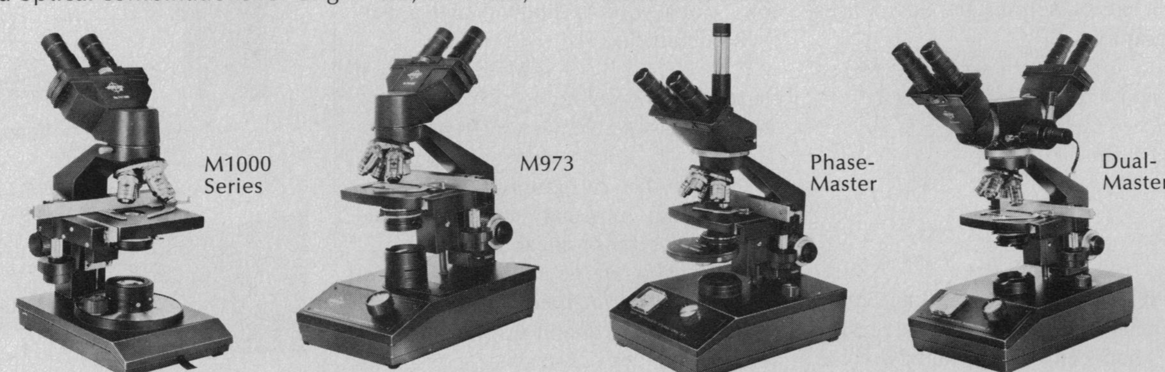


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costs are at the heart of the publication problem, which can be divided into seven elements: (i) generation of original material; (ii) motivation for (i); (iii) evaluation of written material; (iv) editing of written material; (v) motivation for (iii) and (iv); (vi) production of user's hard copy; and (vii) distribution.

The book system takes care of (ii) with royalties to the author, and of (v) with reimbursement and profits to the publisher. In xerography, (vi) and (vii) are partially interchanged in time, using a few publisher-distributed hard copies to generate many locally printed copies, evading the internalization of costs (ii) and (v).

Even without royalties, authors will generate new material: witness scientific papers. But publishers cannot publish at a loss forever. Xerography is a parasitic technology: it needs something to copy. If books disappear we will presumably be left with typewritten copy which can be fed into computer networks. If elements (iii) and (iv) are lacking we will surely be swamped with more trash.

If, on the contrary, the evaluation and editing now carried out by publishers are transferred to juries of peers, supported by the government, will the result be better or worse? Anyone who looks with equanimity to the imminent destruction of the host (conventional printing) by the parasite (xerography) should justify such meliorism.

GARRETT HARDIN
*Department of Biological Sciences, University of California, Santa Barbara 93106*

## Oil Spills and Offshore Drilling

The article by William B. Travers and Percy C. Luney "Drilling, tankers, and oil spills on the Atlantic outer continental shelf" (19 Nov. 1976, p. 791) is directed at a timely problem, but the comparison it purports to make is flawed by an incomplete argument, factual errors, and a misuse of oil spill statistics taken from a report we coauthored (*1*).

We begin with the factual errors:

1) Travers and Luney state that "Since 1972 no major oil spills have occurred." Presumably the authors were unaware of the spills listed in a U.S. Geological Survey (USGS) annual report (*2*) (Table 1). There was also a large spill from the Cobia pipeline on 9 September 1974, but this incident only involved 2213 barrels, so it wouldn't fit into Travers and Luney's criterion for a "major spill" (more than 5000 barrels).

2) The authors say that before 1969 "more than 7000 wells were drilled . . . without a large oil spill occurring." Tables 1 and 5 in their article refer to four spills associated with drilling, production, and pipelines before 1969, three of which are more than 5000 barrels. St. Amant, an observer of the Gulf Coast outer continental shelf (OCS), thinks (*3*) that the worst of the Gulf spills occurred about 1961. The CATCO platform, 30 miles off Empire, Louisiana, caught fire. The fire was extinguished by dynamiting, and the well then ran crude oil for a week. A 50-square-mile slick came ashore and then blew out again, with apparently no permanent damage. Spills were not reported in those days, but this spill is well known to those who were active in offshore production at that time.

3) The authors also say that "No blowouts have occurred during drilling in the U.S. Gulf region in the past 5 years." The USGS (*2*, table A, pp. 7–11) lists 14 blowouts in the years from 1972 through 1976. One involved the complete loss of a rig. One involved heavy fire damage and three injuries. One burned for 2 days, spilling an unknown quantity of oil. Not all of these blowouts were associated with drilling (three were caused by hurricanes), but the comparison the authors purport to make between tanker imports and offshore production would appear to obviate such semantic distinctions.

In addition, there are a number of statements in the article that are logically incomplete, making review difficult. For example:

1) "Unreported spills have been significant because official offshore reports have not included tanker spills occurring in harbors or near terminals, and the Coast Guard's authority for reporting vessels extends only to the 3-mile territorial waters limit." The reference is to our report (*1*, p. 90), in which we simply said that tanker spillage was well reported in U.S. harbors and nearshore areas, but that the Coast Guard's authority for regulating oil spillage extended only to 3 miles (for foreign tankers), and so we were not sanguine regarding the completeness of the offshore ship spillage records.

2) "Offshore production and pipelines invariably introduce less crude oil and petroleum into the environment than do tankers and sources of automobile waste oil (Table 3)." A comparison like this raises the possibility of comparing every offshore activity with some "baseline" activity like sailing. Obviously we should like to know the payoff as well as the price, and so the figures of table 3 tell on-

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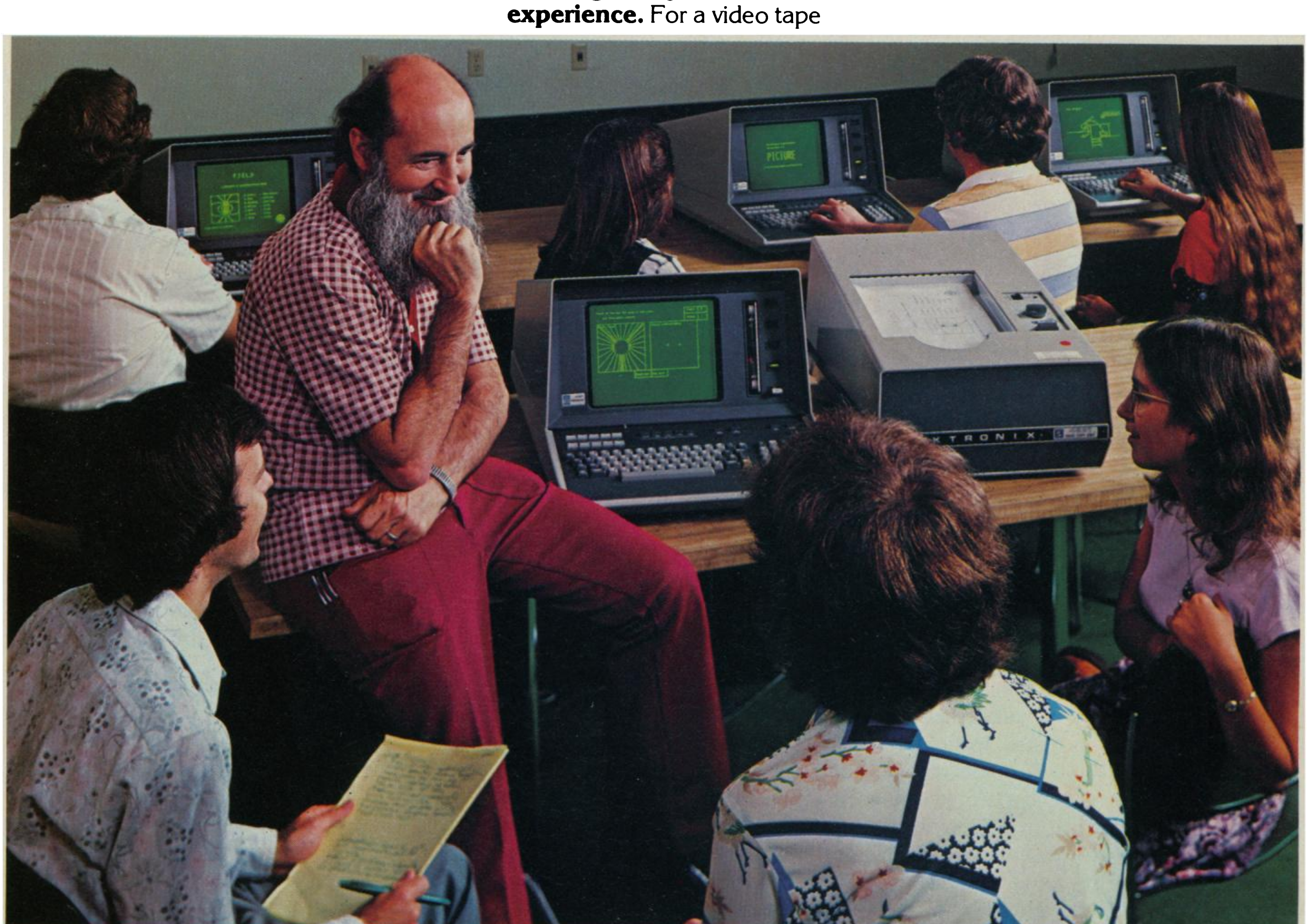

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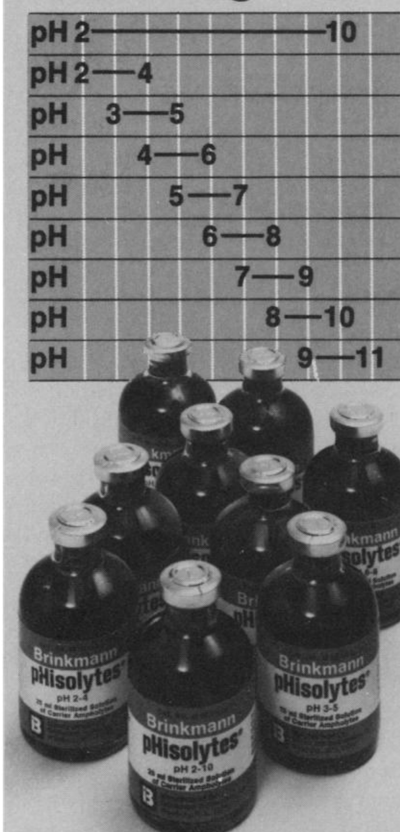


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way into the PIRS data (*5*, pp. 25–27). However, the factor of 10 differences between the number of spills for tankers and OCS production suggest that a comparison made solely on the basis of environmental considerations is liable to favor the tanker import alternative.

In the heated atmosphere surrounding the offshore leasing program, it seems inevitable that our remarks will be interpreted in an adversary situation, and probably used against the leasing program. This was not and is not our purpose. We both believe that OCS development can be carried on in an environmentally acceptable fashion. Further, the economic benefits that may accrue through an OCS leasing program are enormous. We strongly support the program for these reasons.


ROBERT J. STEWART
*Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration, Seattle, Washington 98105*

J. W. DEVANNEY III
*Department of Ocean Engineering, Massachusetts Institute of Technology, Cambridge 02139*


**References and Notes**


1. J. W. Devanney III and R. J. Stewart, "Analysis of oil spill statistics," in *Primary, Physical Impacts of Offshore Petroleum Development* (Report No. MITSG 74-20, Massachusetts Institute of Technology, Cambridge, 1974).
2. Conservation Division, "Accidents connected with federal oil and gas operations on the outer continental shelf" (U.S. Geological Survey, Reston, Va., 1976), table E, pp. 9–11.
3. L. St. Amant, personal communication.
4. The figures for the volume of crude oil brought into the three ports are from the Army Corps of Engineers [*Waterborne Commerce of the United States* (New Orleans, La., 1973–1975), vols. 1 and 4 for each year], and the offshore production values are taken from the Conservation Division, *Outer Continental Shelf Statistics* (U.S. Geological Survey, Reston, Va., 1951–1975). An approximate conversion of 6.5 barrels per short ton was used to convert the Corps of Engineers data into barrels.
5. R. J. Stewart, *A Survey and Critical Review of U.S. Oil Spill Data Resources with Application to the Tanker/Pipeline Controversy* (Report to the U.S. Department of the Interior, Martingale, Inc., Cambridge, Mass., 1976), p. 54.


Travers and Luney have produced an interesting and useful assessment of the probability of blowouts occurring during Atlantic outer continental shelf (OCS) oil and gas exploration and development. Their analysis, however, falls far short of proving their thesis—that the geologic conditions of the Atlantic OCS make the development of its oil and gas resources "environmentally preferable" to increasing imports of oil in foreign-flag tankers. In making the social choice of whether or not to develop petroleum resources on the Atlantic OCS, and, if so, what regulations or restrictions are necessary, we are compelled to consider a broad array of socioeconomic, political, geological, and biological facts that such a choice involves. The authors' sweeping conclusion is based on only two components—blowouts and tanker performance—of this very complicated issue. Below we discuss the major points we think Travers and Luney have overlooked.

1) We agree with the authors' assessment that tankers represent a major source of oil spills. This fact has been demonstrated since the publication of their article by the grounding of the Liberian tanker *Argo Merchant* on the Nantucket Shoals, which produced the worst oil spill ever to occur in North American coastal waters. Moreover, 1976 proved to be the worst year in history for tanker mishaps (*1*). However, we cannot agree that the use of tankers will decrease as a result of oil and gas development in the North Atlantic. To the contrary, production of oil and gas from the area covered by Lease Sale 42, which includes Georges Bank, will probably result in an *increase* in tanker traffic. The estimate of oil and gas resources recoverable from that area is too low to economically justify the use of pipelines for transport of oil ashore (*2*, p. 631), making small tankers (20,000 to 30,000 dead weight tons) the most probable mode of transport. Use of these smaller and generally older tankers could result in chronic discharge of oil and more accidents. Moreover, as no refineries are located in the New England region, piping oil ashore would not eliminate the need for tanker transport of the same crude oil to refineries, presumably those in the mid-Atlantic states, and the subsequent return by tanker of refined oil to New England.

2) The offshore regions of New England have historically been and continue to be areas of intensive fishing activity. The extension of U.S. fishing jurisdiction to 200 miles offshore last year gives assurance that the nation's dependence on and stake in the protein resources of Georges Bank, one of the world's prime fishing areas, and other fishing areas will continue to be of the highest priority. A meaningful discussion of the environmental preferability of any activity in the North Atlantic must, consequently, include an assessment of the impact of anticipated activities on fisheries resources. Such a discussion is notably absent in the article by Travers and Luney; nowhere is there mention of the environmental consequences of the introduction of thousands of tons of drilling muds, drill cuttings, and formation waters into the marine environment. Moreover, the authors do not discuss the impact of

physical obstruction of fishing activities by drilling rigs, platforms, and pipelines; nor do they attempt to assess the impacts that the release of hydrocarbons from OCS activities will have on marine biota.

3) Bottom currents over Georges Bank are very strong and, as a result, sediment transport is very active. Large sand waves and ridges cover a sizable percentage of Georges Bank and the Nantucket Shoals (*3*). Some of these features have migrated up to 305 meters in a 25- to 28-year period (*4*). Smaller sand features move at a much greater rate. The migration of these sand waves and the extensive sediment transport that occurs in general represent significant geologic hazards that the authors do not mention. Sediment erosion and transport could result in partial or complete removal of sediment cover emplaced to protect pipelines (if used) from anchor dragging and impacts resulting from fishing activity. While pipelines have a low casualty rate, when they rupture a disproportionately large volume of oil is spilled. Between 1967 and 1975, 202,199 barrels of oil were spilled due to pipeline breaks or leaks (*2*, p. 628). In addition, the frequency of pipeline failure has increased from seven incidents in 1969 to more than 40 in 1975; sediment transport appears to be responsible for more than half of these failures (*5*).

4) Another geologic hazard that is not considered is the presence of high concentrations of the light hydrocarbons methane and ethane in bottom sediments on the southern margin of Georges Bank on the upper continental slope (*6*). The presence of gas in high concentrations in bottom sediments can lead to bottom sediment instability that could result in platform or pipeline failure and spillage of large volumes of oil.

5) Travers and Luney contend that the adverse effects of OCS development can be diminished by "the implementation of tighter safety standards and closer supervision and surveillance by state and federal government officials. . . ." This argument should be scrutinized bearing in mind two important factors. First, the role of state government in OCS development is one of observer. The Supreme Court has ruled (*7*) that OCS activities beyond 3 miles offshore are under the domain of the federal government, and there has been a resulting decline in the ability of the coastal states to have influence in federal policy-making. Second, the ability of any federal government agency to diminish pollution stemming from OCS activities is limited to a great extent by the existing technology for dealing with spilled oil. While there are a number of measures that can and should be taken to prevent oil spills, there is little doubt that accidental discharges will continue and cleanup will be necessary. It is painfully clear that the technology to handle oil spills in seas greater than 5 feet does not exist. Since seas in the North Atlantic are frequently greater than 5 feet and often 15 to 20 feet (*2*, pp. 184–189; *8*), most spills that occur will undoubtedly be dispersed by the prevailing winds and currents and could affect important natural resources.

Thus, from an environmental standpoint, it may, in fact, be preferable to import foreign oil rather than produce oil from the OCS. A complete analysis of the merits and problems of OCS exploration and development, however, requires consideration of social, political, and economic factors, in addition to environmental concerns.

One final factor that should be taken into consideration is that stricter regulation of tankers could greatly reduce the amount of oil in the marine environment, lessening the impact of our current dependence on tanker imports. The Ports and Waterways Safety Act of 1972 mandated the Coast Guard to promulgate regulations on tanker design, construction, maintenance, and operations. Furthermore, as the authors have pointed out (but not emphasized), the United States can prohibit the entry into territorial waters of any ship that does not meet domestic safety requirements. While the Coast Guard for years has failed to promulgate most of the regulations pertaining to the Ports and Waterways Safety Act, recent events may inspire a more concerted effort on the part of the United States to tighten tanker safety requirements. President Carter has recommended a number of actions that the federal government can take to improve tanker safety, including requiring double bottoms, segregated ballast, inert gas systems, collision avoidance systems, and upgrading of crew training standards.

In all, however, it is clear that the United States has the legal mechanisms to substantially diminish the amount of oil spilled into U.S. coastal waters by tankers and, in light of this, the argument that OCS development will do more to decrease oil spills by reducing tanker traffic is questionable.

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Sokoloff, L. et al, "Mapping of Functional Neural Pathways by Autoradiographic Survey of Local Metabolic Rate with [$^{14}$C] Deoxy-glucose," SCIENCE, *187*, 850–853 (March 7, 1975).

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We are pleased that Stewart and Devanney agree with our principal conclusion: that drilling for oil on the U.S. Atlantic outer continental shelf (OCS) is unlikely to cause a major oil spill and, consequently, "OCS development can be carried on in an environmentally acceptable fashion." We are puzzled, however, that such a long letter is needed to point out that analysis of slightly different data on recent oil spills leads them to the same conclusion as ours. We wish, as we expect they do, that better oil spill statistics existed for the years before 1972. We believe that little is gained by debates about statistical methodology when incomplete statistics are used. The crucial point is that the U.S. continental shelves are not dangerous environments in which to drill for oil. And, from a geologic perspective, the U.S. Atlantic OCS is one of the safest continental shelves in the world. Unfortunately for the debate on the environmental consequences of Atlantic OCS leasing and drilling, the critique by Stewart and Devanney contains errors, omissions, and irrelevant statistics. They ignore the geologic conditions of the Atlantic OCS and do not consider modern offshore drilling and production practices.

The alleged oil spill in 1961 from a CATCO platform off Empire, Louisiana, in all probability did not occur. Petroleum industry records, U.S. Geological Survey (USGS) data (*1*), and local newspapers contain no mention of a major oil spill in 1961 from an offshore platform. In recent interviews conducted by one of us (W.B.T.) with several oil industry engineers and USGS geologists who have worked in Louisiana since the 1950's, no one was discovered who remembered such a spill.

In the second paragraph of our article, we discussed oil spills from blowouts and said that no major spills have occurred since 1972. The sentence should have read "since 1973." In the relevant paragraph we were not discussing oil spills from pipelines. In all cases of oil spilled from platforms since 1972, the USGS reports, "No recorded environmental damage" (*1*, table C, pp. C3–C5).

In their point 3, Stewart and Devanney state that numerous blowouts have occurred in the Gulf of Mexico from 1972 to 1976, but do not mention that these were, without exception, essentially gas blowouts that spilled little oil, or more commonly, spilled no oil at all. Gas blowouts are dangerous to personnel, costly, and are certainly to be avoided, but they do not spill oil, and they do not threaten the marine ecosystem. By lumping gas blowouts with oil spills, Stewart and Devanney distort the debate over the environmental consequences of OCS petroleum development.

Further, we speculate that the hydrocarbon found on the Georges Bank and Baltimore Canyon areas will be largely natural gas because the most attractive potential hydrocarbon traps appear to us to be in sedimentary strata that were deposited in nonmarine and brackish water environments which usually generate only gas. Obviously, oil spills cannot come from wells producing only natural gas.

As further indication of the insignificance of older spills (pre-1970), we note that, in 1969, the late, highly regarded director of the USGS, W. T. Pecora said, in writing about the January 1969 Santa Barbara oil spill, "The Santa Barbara incident was the *first significant* oil-pollution experience resulting from drilling or working 7860 wells under Federal jurisdiction on the Outer Continental Shelf since 1953" [italics added] (*2*). After this statement was written, two large spills from platforms occurred in the Gulf of Mexico in 1970. Minor amounts of oil were reported on local beaches (*1*, table B, pp. B6 and B8).

Stewart and Devanney criticize us for stating that, "Offshore production and pipelines invariably introduce less crude oil and petroleum into the environment than do tankers and sources of automobile waste." We know of no data that contradict our statement. A 1975 report of the National Academy of Sciences (*3*) puts the volumes of oil spilled from platforms in perspective. Of the total input of hydrocarbon into the oceans, only 1.3 percent comes from offshore production, while tanker operations account for 34.8 percent and urban and river runoff for another 31.1 percent. A quote from a recent USGS publication (*4*) is instructive: "Furthermore, no spill in excess of 50 barrels has been recorded during *explor-*

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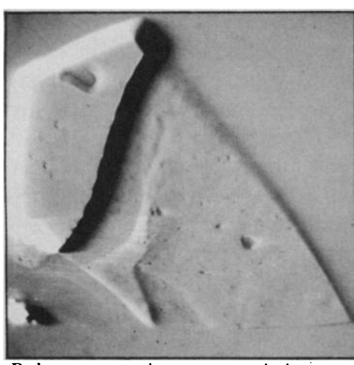
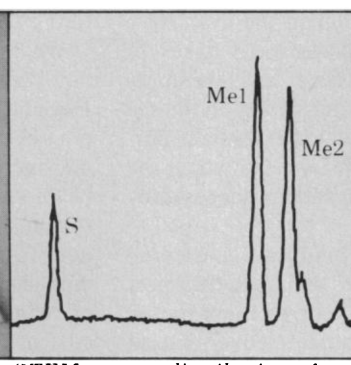


*Polymer specimen containing thin metal wire.*

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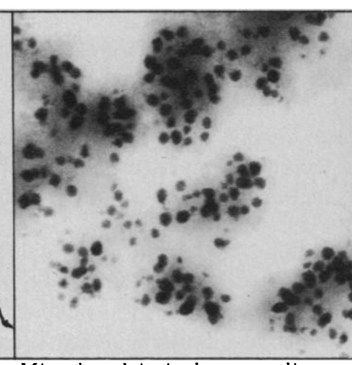
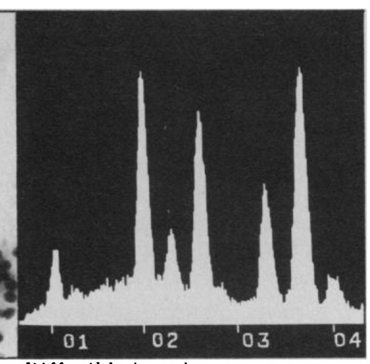


*Mitochondria in brown adipose tissue of rat.*

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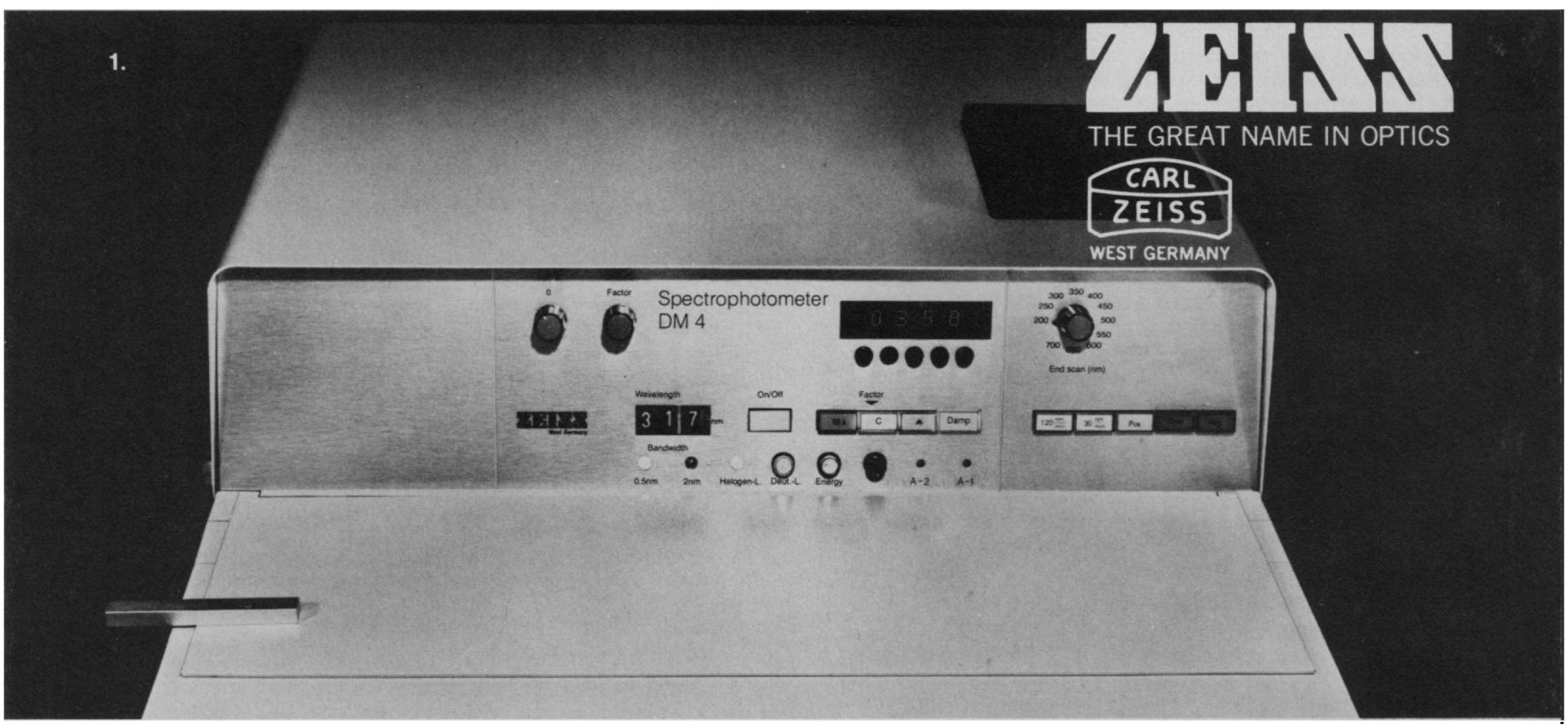


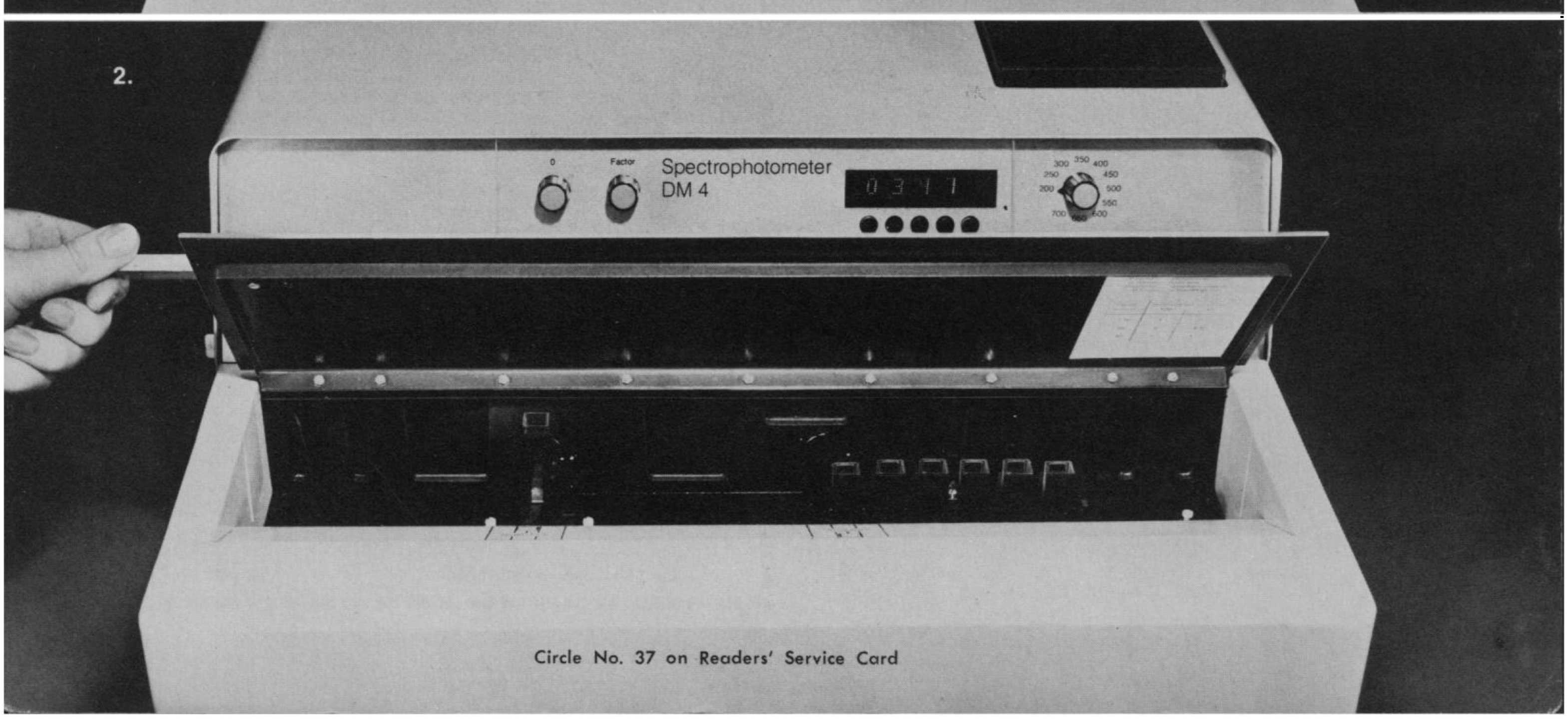


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## Recombinant DNA Legislation

During 1977 the scientific community escaped a threat to the freedom of inquiry in the form of harsh legislation. The ostensible target was alleged hazards of recombinant DNA, but objectives of some of the proponents were broader. The escape from restrictive legislation may prove to be only temporary. Last year congressional action was delayed in part as a result of extremely effective lobbying by scientists, especially a group headed by Harlyn O. Halvorson. If biologists relax the battle could be lost. Moreover, irresponsible acts by individual scientists could be very damaging.

One of the ironies of the situation is that biologists drew lightning to themselves. As long ago as the early 1960's some leading biologists were warning of ethical problems they envisioned as arising from genetic engineering. These warnings proved premature, but they were given prominence in the media. Statements discounting the imminence of genetic engineering received little attention. Gradually the public became uneasy about a hazard it could neither evaluate nor, perhaps, control.

The recombinant DNA technique that became available in 1973 opened new vistas in genetic research. It made possible the preparation of large amounts of individual genes. It also made possible the incorporation into the genome of chemically synthesized pieces of DNA. Molecular biologists who first became aware of the new developments could envision all kinds of experiments, some of which they felt might produce new pathogens. Seeking to be responsible citizens, they called attention to the matter and recommended a moratorium on some experiments.

In July 1976 the National Institutes of Health published guidelines that were soon made applicable to all research performed under federal grants. The guidelines permitted use of certain nonpathogenic mutants of the K-12 strain of *Escherichia coli* for recombinant DNA experiments. The containment procedures required were reasonable and adequate.

However, the long series of warnings about genetic engineering had created a climate of public opinion favorable for critics of recombinant DNA research. Though relatively few in number, their influence was great. The relevant committees of Congress accordingly prepared restrictive legislation. Because of the pressure of other business, Congress did not act quickly. In consequence, there was time for lobbying against the bills. In addition, during 1977, Roy Curtiss III produced further information that minimized potential hazards arising from the K-12 *E. coli* mutants. Halvorson and others pointed to the fact that extensive work with pathogens at Fort Detrick and the Center for Disease Control in Atlanta had not led to contagion among the families of microbiologists. Stanley Cohen showed that nature was already performing many of the experiments that the legislation proposed to regulate.

But some kind of legislation seems likely. At present, industrial laboratories are not compelled to follow the NIH guidelines. However, in the process of regulating industrial laboratories, almost anything can happen depending on the public mood of the moment. When such legislation is finally adjusted in a conference committee of the House and Senate, strange provisions can enter that bear little relation to the original bills.

A major hazard is that during the crucial moments of the legislation, news will come out of some irresponsible act by a scientist engaged in recombinant DNA research. This need not be an act of substance. Already at the Stevenson hearings in November, it was made clear that failure to complete some paper work could draw censure.

Today recombinant DNA research is highly productive, highly competitive. Workers are under temptation to take shortcuts. But they should behave as if their every act is under scrutiny, for indeed it is—by assistants, colleagues, or competitors. A scientist who furnished the pretext for restrictive legislation could count on the ill will of many of those he or she most wants to impress.—PHILIP H. ABELSON

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For more information on the systems (and accessories) shown, just write: Brinkmann Instruments, Inc., Cantiague Road, Westbury, N.Y. 11590. In Canada: Brinkmann Instruments (Canada) Ltd.

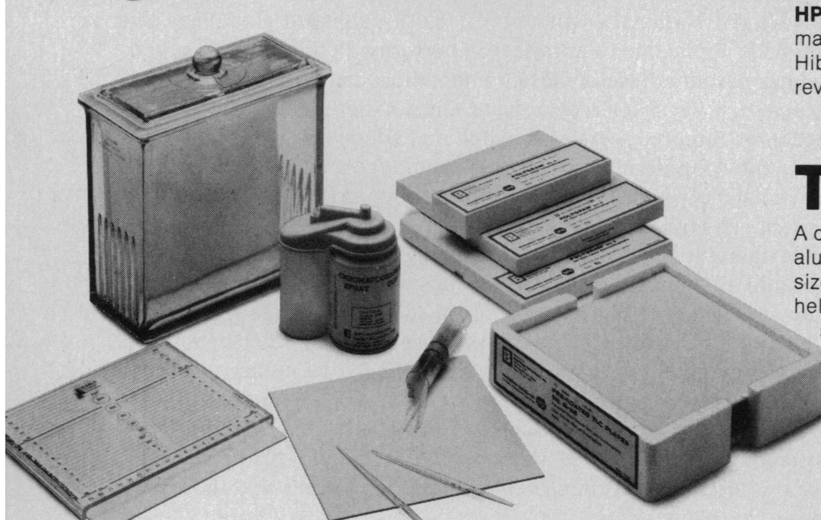
## CC-HPLC

For Column Chromatography and High Pressure Liquid Chromatography, Brinkmann has one of the most extensive selections of pre-packed columns, apparatus and sorbents in a variety of types and particle size distributions.

**CC:** Choose from 3 sizes of pre-packed Lobar™ columns filled with silica gel 60. An injector stand is available that fits all three columns and incorporates an injection port, pump and column connection.

**HPLC:** Brinkmann's High Pressure Liquid Chromatography line features pre-packed stainless steel Hibar™ columns, available in 11 types, including adsorption, reverse phase, polar and weak polar phases.

Circle No. 28 on Readers' Service Card



## TLC

A complete line of high quality pre-coated glass plates, aluminum and plastic backed sheets in a wide variety of sizes, as well as loose sorbents. Also the apparatus to help perform the separation, including developing tanks, streaking devices, applicators and spot collectors.

Circle No. 36 on Readers' Service Card

## TLIEF

Brinkmann TLE Single and Double Chambers let you perform the entire range of electrophoretic separations, both analytical and preparative. The Double Chamber handles separations as large as 20 x 40cm, or as small as a microscope slide, with outstanding resolution and reproducibility. For Isoelectric Focusing, carrier ampholytes are available in one general and eight individual pH ranges encompassing pH 2-11. A combination electrode permits direct pH readings.

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