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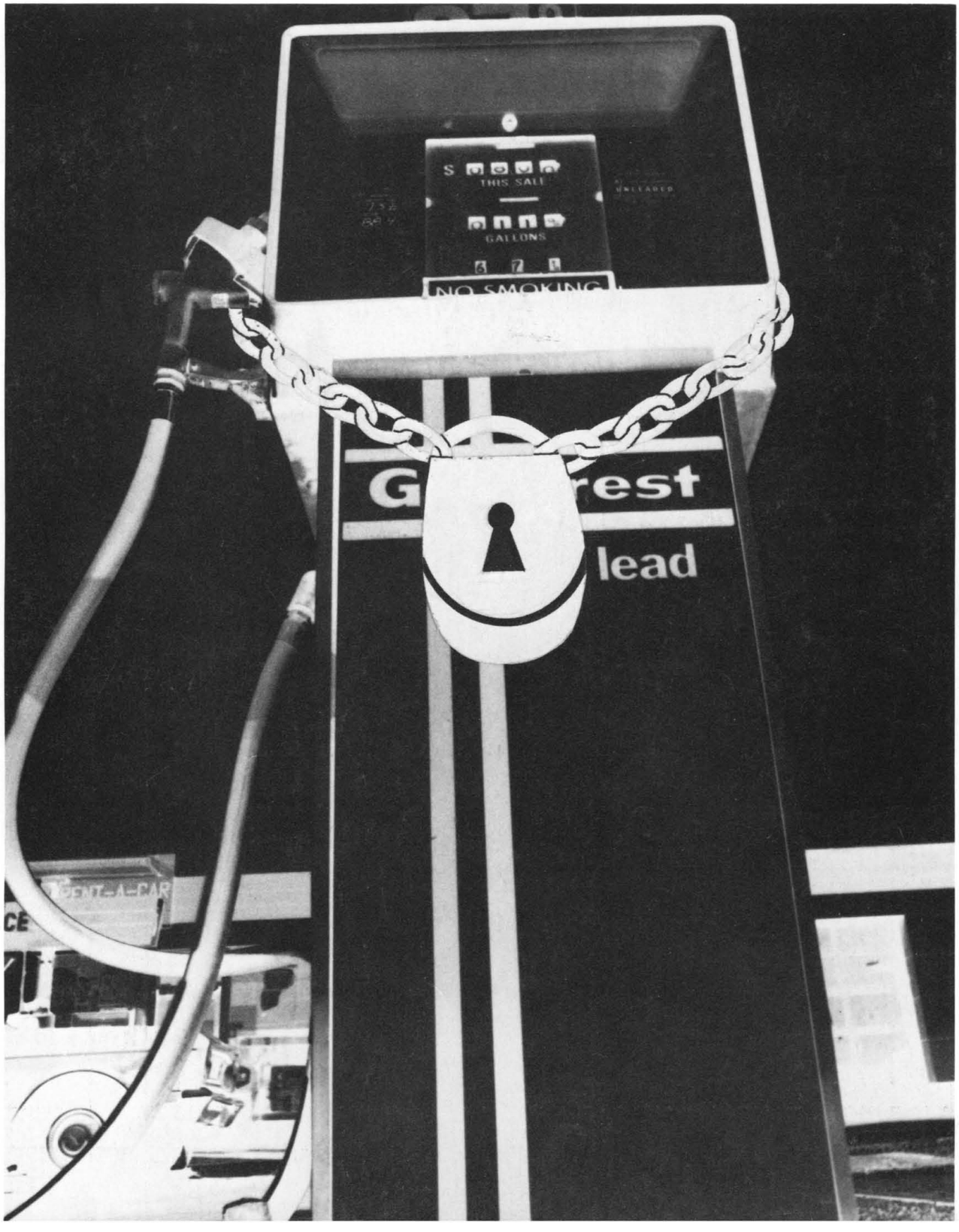

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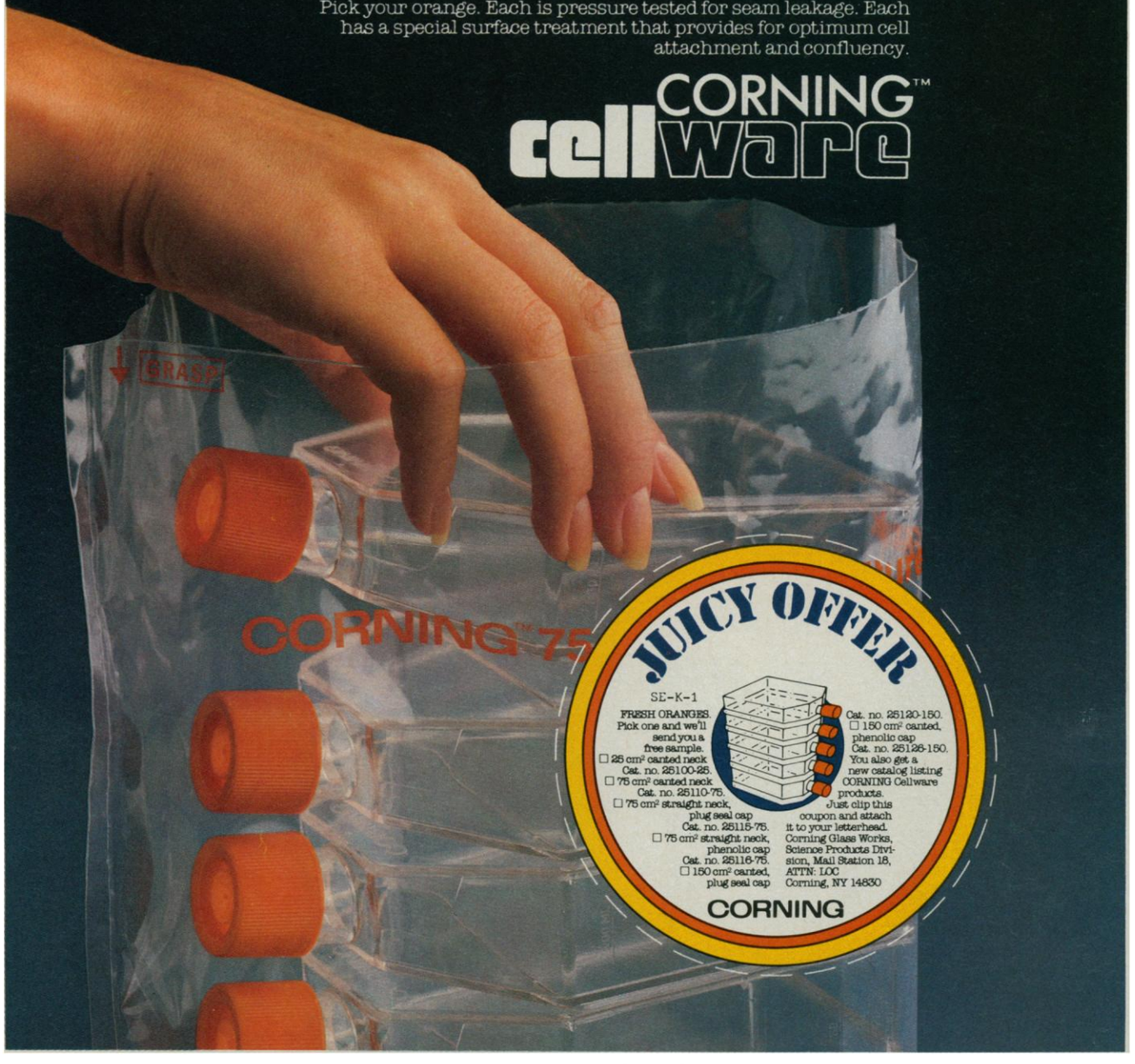

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Artist's concept of distribution problems brought about by decreasing availability of petroleum. Petroleum resources are finite, and this will eventually place restrictions on end uses. See page 233. [Stephen Shepherd, Silver Spring, Maryland]

VAX-"An implementor's dream."

—Dr. Brian Ford, Director, Numerical Algorithms Group
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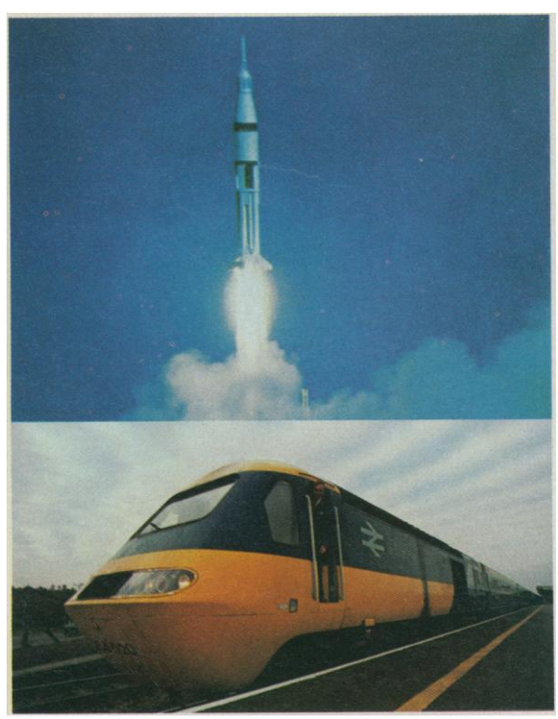

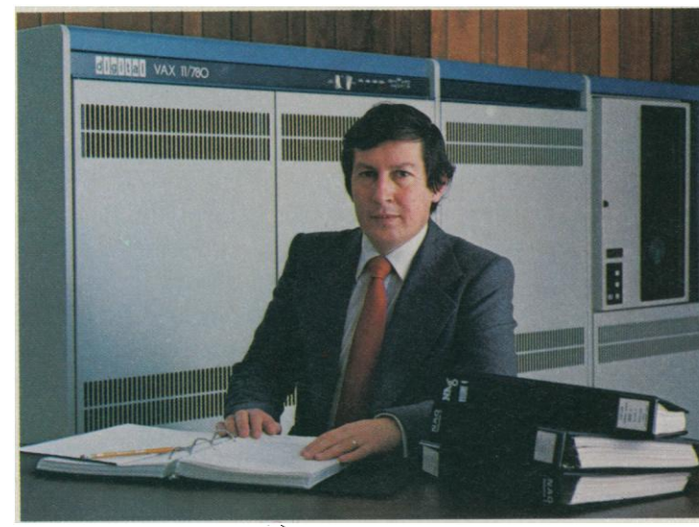

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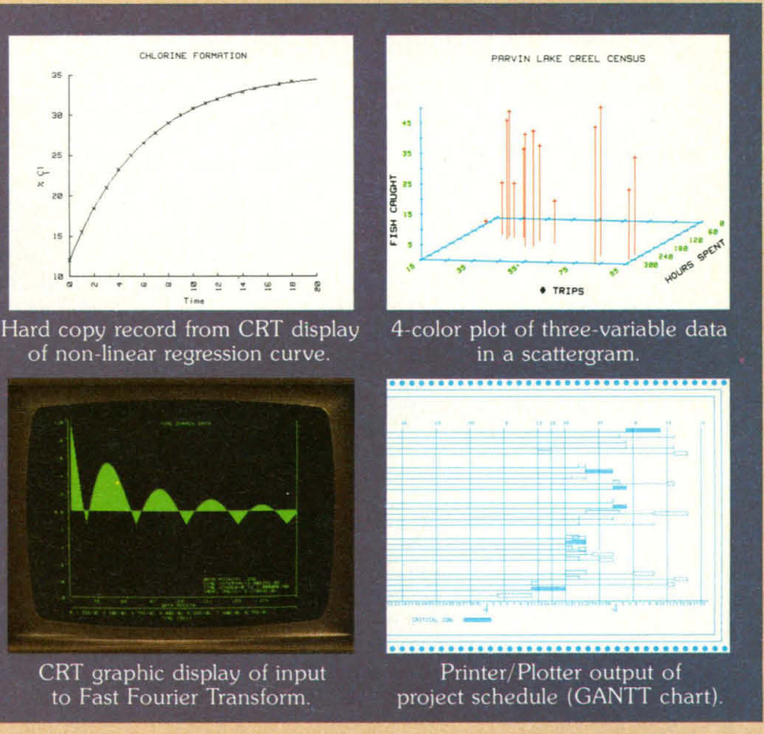

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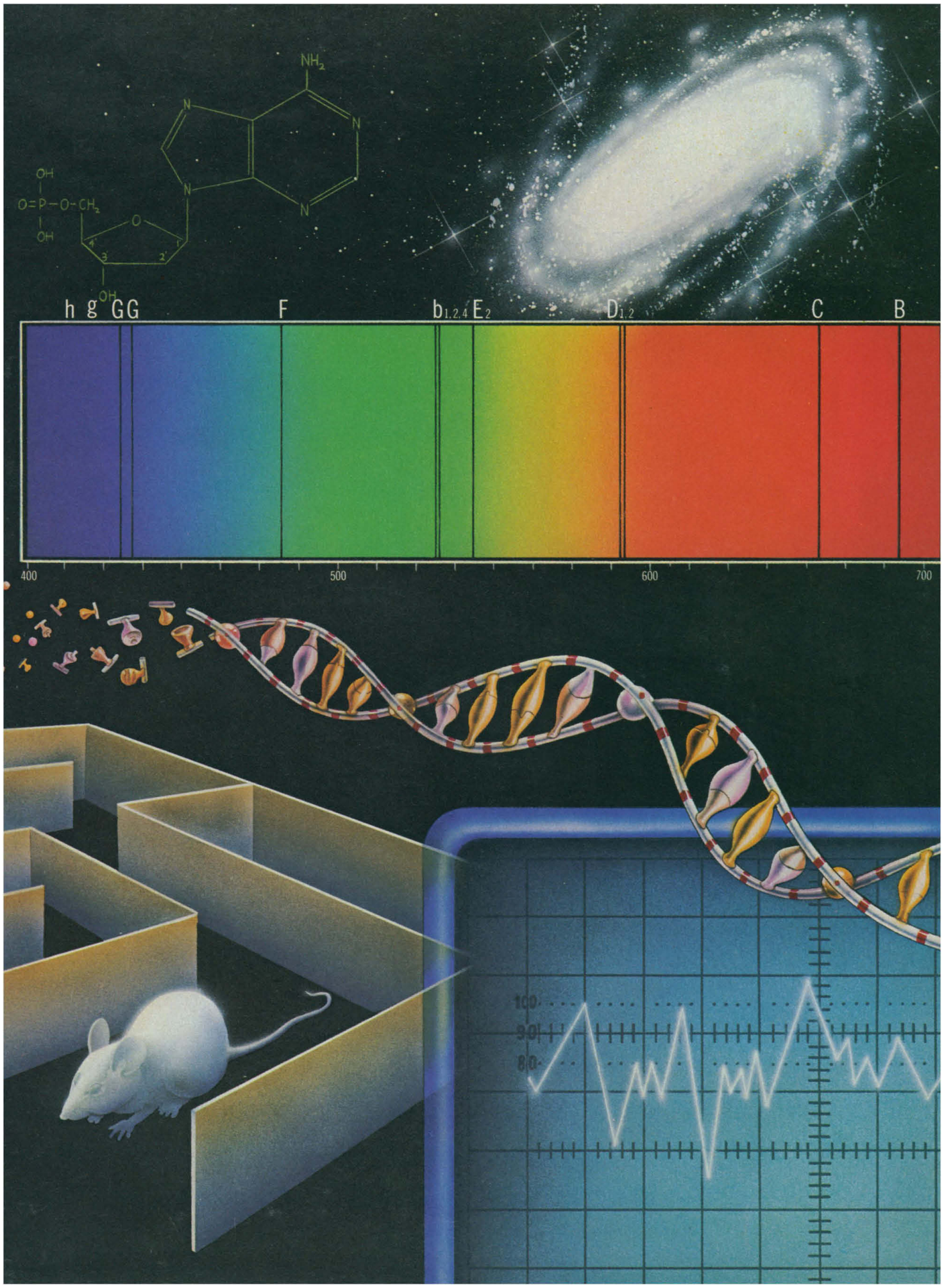
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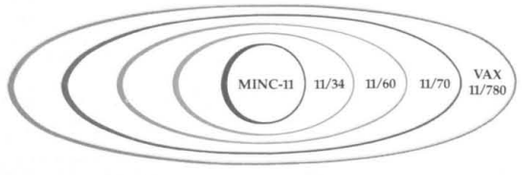

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LETTERS

A Poet's "Education"

The highly asymmetric notion of "education" embodied in the Harvard Core Curriculum (News and Comment, 8 Dec. 1978, p. 1063) perpetuates a historical accident. The humanists were the first to define "education" long ago; and, not surprisingly, they defined themselves as the model of what ought to be. We are all still imbued with that old idea. We think it terrible if a person studies chemistry/math/physics and learns nothing of the humanistic side of the world. But no one looks askance if a person spends 4 years in history/literature/poetry and remains ignorant of the physical world.

A science school such as Caltech requires its students to spend one-quarter of their time in the humanities: that's what it means to be "learned" after all. But is there a humanities department, anywhere, that believes it is important for people to comprehend the issues behind recombinant DNA research, or the trade-offs between nuclear and fossil fuels?

Despite the increasing importance of science in our society, most people remain ignorant of even its simplest concepts. For such "educated" people, the world operates as though by magic; they are at the mercy of any random failure of a device or any dishonest technician. And we, in turn, are all at their mercy when they are asked to make policy decisions involving scientific matters.

Those who will not understand science become, instead, its prisoners. Such people can feel smug in their cultural knowledge until the pilot light in the furnace goes out or until they are asked to use, or not use, a particular chemical compound, because of tests they cannot understand, performed according to the principles of a scientific methodology whose purpose they do not comprehend.

Has our "educated" poet really been liberated from the suffering of Chemistry I or merely been made the slave of a cancer quack?

CHARLES A. LAVE
School of Social Sciences, University of California, Irvine 92717

Occupational Cancer Risk

In his article of 10 November 1978 (News and Comment, p. 602) Thomas H. Maugh II summarizes various industry-generated criticisms of the Department of Health, Education, and Welfare

(HEW) draft report "Estimates of the fraction of cancer in the United States related to occupational factors" (*1*)—criticisms that unfortunately lead him to conclude that the HEW projections are invalid. While this letter is not intended to present a detailed rebuttal to these criticisms, it offers a general response to Maugh's comments and puts the issue of occupational cancer risk estimation in better perspective.

Because of the numerous assumptions that must necessarily be made about the level of past exposures, size of the population at risk, and so forth, it is difficult, if not impossible, to generate any single estimate of the number of occupationally related cancers that is not vulnerable to at least some degree of criticism. Nevertheless, the purpose of the HEW report was to demonstrate that a careful consideration of the *multifactor* etiology of most cancers would indicate that occupational exposures play a more significant role in the onset of this disease than has been generally recognized.

One of the major arguments offered to support the claim that the HEW figures are grossly inflated rests on assertions that the risk estimates used in the government document are far too high, and that they do not reflect current industrial exposure levels. Maugh states that the HEW investigators "in each case" took "the highest risk ratio available" in making their projections. This is clearly not true, as inspection of table 2 (*1*, p. 33), the accompanying notes (*1*, pp. 34-38), and the related references—particularly (*2*)—would reveal. Furthermore, as the average latency period for most occupational cancers ranges from 15 to 35 or more years, it is obvious that the bulk of industry-associated cancers that will appear over the next one to two decades will result from initial exposures that occurred typically before 1960. (For example, many of the current mesothelioma deaths are likely to be related to initial exposures during World War II.) Thus, recent reductions in exposure levels—often brought about by federal regulation and intervention—are not likely to markedly alter the incidence of tumors in these cohorts in the next one to two decades.

The HEW investigators are also accused of having ". . . rather sloppily equated deaths with incidence." Although this statement is not really accurate, as a careful reading of the footnotes to table 2 of the HEW document will attest, it is a "strawman" issue in any event. The major occupational cancer of concern in the HEW report is respiratory tract cancer, which is characterized by an exceedingly poor prognosis. Thus,

the case detected this year is almost sure to become next year's fatality.

Finally, the HEW document is severely criticized for (allegedly) overestimating the magnitude of the population at risk. The use of figures derived from the National Occupational Hazard Survey of 1974 is particularly condemned on the basis that the survey data reflected potential exposures at any level rather than actual exposures at levels sufficiently elevated to increase risk. Clearly population-at-risk figures are among the most difficult to ascertain in making the projections under discussion: in some cases populations at risk could be overestimated, in other cases underestimated. However, the error associated with this potential overestimate may not be so significant as industrial critics suggest because turnovers among the cohort of workers who will contract the occupational cancers of the next two decades have not been taken into account. Furthermore, the HEW projections did not include any estimates of the industry-related tumors likely to occur among the many occupational groups in which excess cancer incidence has been reported but for which a specific etiologic agent has not yet been identified. Nor did they include any projections of excess risk from exposures to chemicals, such as epichlorohydrin, shown to be carcinogenic in laboratory animals but not yet studied in human populations. For these reasons, any present estimate of future occupational cancer risk could be conservative.

DAVID P. RALL

National Institute of Environmental Health Sciences, Post Office Box 1223, Research Triangle Park, North Carolina 27709

References

1. "Estimates of the fraction of cancer in the United States related to occupational factors" (National Cancer Institute-National Institute of Environmental Health Sciences-National Institute of Occupational Safety and Health, Washington, D.C., 15 September 1978).
2. P. Cole and M. B. Goldman, in *Persons at High Risk of Cancer: An Approach to Cancer Epidemiology*, J. F. Fraumeni, Ed. (Academic Press, New York, 1975), pp. 167-184.

Hypothesis Testing

The authors of the important article "Cognitive development and social policy" (23 June 1978, p. 1357) quote, as have so many others, a conclusion of Record, McKeowan, and Edwards (*1*) pertaining to the intelligence of twins. The latter authors erred, however, in concluding *from their data* that the in-

tellectual deficit of twins is due to a deficit in the postnatal environment. Since the conclusion in question represents a common misuse and misinterpretation of hypothesis testing in statistics, setting the matter straight is of wider interest than as it pertains to factors in cognitive development. The mean level of intelligence of the surviving member of a twin pair when the other member died very early in development turned out to be about halfway between two expected values: the mean for single-birth individuals and the lower mean for normal twins. Record *et al.* compared the mean in their data with the single-birth mean and were unable to reject the null hypothesis. Thereupon they accepted that hypothesis. If they had compared the mean of their experimental group with the expected value for normal twins, they would also have been unable to reject the new null hypothesis. Obviously both null hypotheses cannot be correct. The solution is also obvious: withhold judgment until more data can be gathered.

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References

1. R. C. Record, T. McKeown, J. H. Edwards, *Ann. Hum. Genet.* **34**, 11 (1970).

We thank Humphreys for his attention to our article on cognitive performance in Warsaw schoolchildren. He makes a point entirely peripheral to the results of our study in Warsaw. However, the result of Record *et al.* (*1*) that he chooses to criticize is an important issue of substance because it sustains the view that family microenvironment is a determinant of IQ. We therefore reviewed their original article.

First, Humphreys is mistaken when he states that the IQ of single survivors of twin pairs is "about halfway between two expected values: the mean for single-birth individuals and the lower mean for normal twins." The actual data are as follows:

Category	Number	Standardized mean IQ
A. Single survivors of twins	148	98.8
B. Surviving twin pairs	1,924	95.2
C. Singletons	41,195*	99.5

*Estimated from (*1*), table 2.

Single survivors of twin pairs score only 0.7 IQ point less than do singletons, and 3.6 points more than surviving twin pairs, which is by no means halfway between the 4.3 points separating singletons and surviving twin pairs.

Second, by our calculations Humphreys is also mistaken in his computation of the statistical significance of these results. As a preliminary step, we examined the statistical power of each comparison. We assumed a standard deviation of 15 throughout. In the comparison of categories A and B, the power to detect a significant result (for a two-tailed test, given the observed difference of 3.6 IQ points) is 83 percent.

In the comparison of categories A and C, given the difference of 0.7 IQ point, the power is less than 25 percent. Nonetheless, the two comparisons have similar power when (with the same numbers, standard deviation, and significance level) they are applied to observed difference of the same size. Thus the test of the two hypotheses, that singleton survivors of twins do not differ from singletons while pairs of surviving twins do so differ, is fair with regard to power.

Record *et al.* made no mention of significance tests, and it is incorrect for Humphreys to say they "were unable to reject the null hypothesis. Thereupon they accepted that hypothesis." We can agree with Humphreys that there is no statistically significant difference between category A (single survivors of twins) and category C (singletons), using the *t*-test. Contrary to Humphreys, however, we *do* find a statistically significant difference between category A (single survivors) and category B (twin pairs) at the 5 percent level. Therefore it seems to us that any need for more data to support this result does not stem from the statistical reason that Humphreys gives, but from the logical reason that a unique and important result should be tested by replication.

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ZENA A. STEIN
Brain Disorders Unit, New York State Psychiatric Institute, and *Gertrude H. Sergievsky Center*

References

1. R. C. Record, T. McKeown, J. H. Edwards, *Ann. Hum. Genet.* **34**, 11 (1970).

Women and *Science* Editorials

Publicly, most scientific organizations are committed to integrating women into professions which, until now, have been dominated by men. Women often claim

that barriers to fulfillment of this goal are so insidious that programs that focus solely on hiring must fail. One commonly cited obstacle is the "old boys network," which provides scientists with those informal supports and contacts so crucial to success.

The AAAS is ostensibly committed to the advancement of all scientists, male and female. Its failure to understand the meaning of such a commitment to women, however, is reflected in its failure to assign weekly *Science* editorials to women. While the request to write an editorial from an organization as influential and prestigious as the AAAS may only reflect the editor's contacts, it serves to enhance the power and status of the author in the scientific community. Women's exclusion from this process is manifested in the disturbing observation that, in the last 25 issues of 1978, a sample likely to be representative of most issues, not a single woman authored a *Science* editorial.

Attainment of affirmative action goals, limited as they are, appears easy in comparison to obstacles such as this. The manner in which the AAAS selects editorial writers requires immediate revision so that women may participate on a regular basis.

ROCHELLE SEMMEL ALBIN
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Cambridge, Massachusetts 02139

Alaska Lands Bill

In his report on the visit to Alaska of Secretary of the Interior Andrus (News and Comment, 11 Aug. 1978, p. 506), Luther J. Carter shows a bias that is common in contemporary reporting on natural resource controversies.

That bias is reflected in the tacit or implied assumption that only the directly affected industries have any reason to oppose the establishment, in mineralized or petroliferous areas, of parks and wilderness areas in which exploitation of mineral and oil resources would be prohibited.

The desire of the mining and oil industries to protect their pecuniary interests through "political muscle" exerted by "lobbyists" (in common usage a pejorative term, whether or not Carter means it that way) is cited as a political obstruction to implementing the goals of preservation. The estimated value of specific mineral deposits is given in dollars, not in reference to annual domestic consumption and production of the commodities to be produced. For the most part, statements made for the production side of the argument seem carefully placed in a frame of industry interest, while those on the preservation side are placed in a frame of national interest.

There is nothing new about this. That's what's discouraging about it. Our professional informers, even when given the opportunity, do not seem to recognize that the conflicts between production-consumption and preservation-simplicity are in each of us, albeit in different proportions; that there are important national—not just corporate—interests involved in a political decision to ban mining and oil production in a promising region; and that weaving straw white hats and black hats may entertain, and even sometimes advance a decision, but does not inform.

The Alaska lands bill argument does not appear to me as simple as either Secretary Andrus or Carter appear to believe it is.

EARL COOK
College of Geosciences, Texas A&M University, College Station 77843

The News and Comment article "Andrus in Alaska: A tour of the wild estate" mentions that "the Porcupine caribou herd, . . . with its some 120,000 animals, is now the largest herd in North America." This is incorrect. The George River herd of the northern Ungava-Labrador peninsula, with more than 150,000 caribou, is the largest in North America, if not the world. A census of the herd was last taken in 1976, and the annual net increment is calculated to be nearly 18 percent; thus the present population may exceed 210,000 animals.

STUART LUTTICH
Wildlife Division,
Department of Tourism,
Post Office Box 376, Goose Bay,
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Collector's Issue?

With all the commotion (Letters, 1 Dec. 1978, p. 930) about the "e" missing from the cover of the 10 November 1978 *Science*, no one has pointed out that the same cover is also misnumbered (4365 instead of 4368). Perhaps that particular issue should be designated a "collector's item."

TIMOTHY NG
Department of Horticulture, College of Agriculture, University of Maryland, College Park 20742

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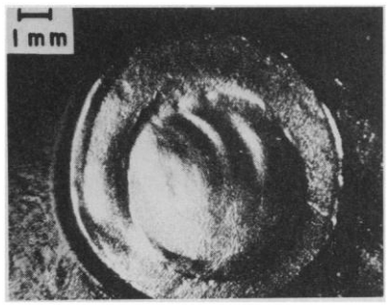
Why O_2 electrodes limit fuel cell voltage.

What suppresses fuel cell output more than anything else? The oxygen electrode. Mysteriously, it refuses to develop the electrical potential that thermodynamics says is possible.

In the H_2-O_2 fuel cell, for example, theory promises 1.23 volts. Yet, reality produces only 1.06.

Many explanations have been proposed to account for this anomaly. But none have withstood scientific scrutiny. Here at the General Motors Research Laboratories, however, we've devised a hypothesis that we're convinced will hold up. It stems from our fundamental studies of the electrochemistry of oxygen.

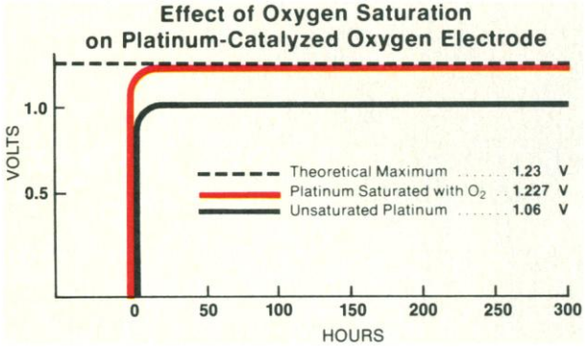


Swelling (area within circular impression) caused by oxygen dissolving into platinum.

Our reasoning: The O_2 electrode is catalyzed with platinum, whose surface adsorbs oxygen. But the adsorbed oxygen continuously dissolves into the Pt lattice, limiting adsorption to about 30% of the Pt surface. Consequently, minute corrosion cells form in the remaining areas, and their combined potential bucks the 1.23 volts.

To test the logic, we charged a pure platinum diaphragm with oxygen. The oxygen did indeed adsorb on the surface and dissolve into the metal, as x-ray analysis and the expanded diaphragm (photograph) later showed.

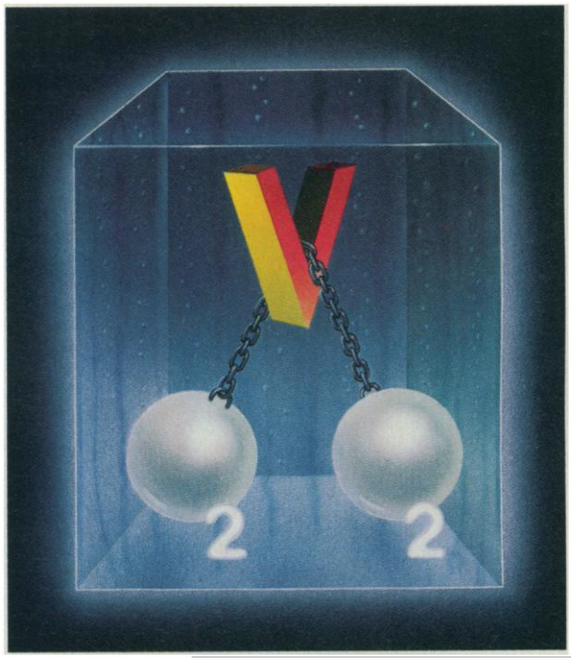
When it became saturated, the diaphragm could no longer dissolve any oxygen. This allowed adsorption to spread over the entire Pt surface, thus preventing corrosion. Now unopposed, the potential between the platinum and a reference electrode climbed to



1.227 volts, the highest ever reported for oxide-free platinum.

Granted, understanding the problem doesn't necessarily solve it. But . . . first things first.

We currently have openings for Ph.D.s in engineering or the physical, mathematical, or biomedical sciences. If interested, please send your resume to: GMR Personnel, Dept. 115. An Equal Opportunity Employer.



GM

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SCIENCE

Counseling the Young

Young people have access to two networks of counselors to provide the information they need for career choices. The first is the formal network of professional teachers and counselors at school. This group is frequently considered to influence the allocation of students to courses and tracks in high school. Ironically, it considers itself helpless in the face of peer pressure, parental pressure, and societal pressure to merely "get by."

The second network of counselors is the informal one of peers, parents, relatives, neighbors, and other people who serve as role models for students. This group is a constant source of influence and information in a context of greater legitimacy and credibility than that of the professionals. Ironically, it suffers from lack of accurate information on supply and demand in the labor force, the kinds of courses needed to meet current demand, and the curriculum best fitted for the particular student's needs, aspirations, and abilities.

In the past, the two counseling networks have dissipated their energies in an exchange of recriminations for failure to meet the needs of students. Professionals have blamed the home and society for the students' lack of motivation. Parents and families have shifted blame back to the schools for providing information that is inaccurate, out-of-date, or delivered too late to rescue high school students from the noncollege track, and college-bound students from the nonscience track.

Readers of *Science* have a special opportunity to contribute to the effectiveness of counseling of the young, both as informal counselors to our own relatives and friends and as formal or informal counselors to educators and school board members. We know the importance of high school algebra and geometry for technical jobs that do not require a college degree. We know the importance of four full years of high school mathematics if one is to survive in freshman calculus. And we know the importance of the "hard" calculus sequence in college for careers in the sciences and engineering. Less well known is the requirement for the "soft" calculus sequence at the undergraduate level for careers in business and management and in economics. For instance, a recent survey of companies planning to recruit employees at a University of Maryland campus showed that only 16 percent were looking for new employees without a calculus background; one-third were looking for at least a soft calculus sequence and one-half were looking for a hard calculus sequence in the undergraduate major.*

Further, the high school mathematics filter has important implications for equalizing employment opportunities. A study of entering freshmen at the University of Maryland in the fall of 1977 showed that 63 percent of white men had 3.5 years of precalculus high school mathematics, compared to only 31 percent of white women, 27 percent of black men, and 19 percent of black women. Increasing employment opportunities for minorities and women clearly depends on providing them with maximal high school mathematics skills so that they will have access to the calculus sequence. Differences in achievement in mathematics represent a loss of human potential as well as ineffective utilization of scarce educational tax dollars.

Equalizing access to high school mathematics skills will create a situation in which everyone wins: students and their families seeking to expand career opportunities, colleges and universities seeking to expand opportunities for minorities and women, and employers seeking to meet the needs for more scientists and technicians.

The critical message for formal and informal counselors to share with the young is that minimal competence means minimal job opportunities: keep your options open by maximizing your competence in mathematics.—LUCY W. SELLS, *Consultant in Educational Research and Affirmative Action, 1181 Euclid Avenue, Berkeley, California 94708*

**Placement Manual, Spring 1978* (Office of Career Development, University of Maryland, College Park, 1978).

Lauda presents three all-new constant temperature baths and circulators designed to provide the fastest, most reliable means of achieving constant temperatures. We call them the S-Series, and you can recognize them by the new digital temperature control on the front panel.

With a flick of the finger, you can set these circulators to within 0.1°C of any desired temperature. Model C-3S has a temperature range from 30° to 99.9°C (from 25°C with tap water cooling), while Models RC-3S and RC-20S have a range from —25° to 99.9°C. Once the temperature is set, forget it; temperature stability is ±0.01°C (±0.02°C below 30°C). That's accuracy, but that's not all.

S-Series models have a safety cut-off for excess temperatures or low liquid levels, a platinum resistance sensor temperature probe, proportional control (PID) that adjusts heater output to effective demand, and zero switching circuitry with RFI suppression.

Choose from a heating circulator with 3-liter bath capacity (Model C-3S) and two refrigerated circulators with 3-liter (Model RC-3S) or 20-liter bath capacity (Model RC-20S). All have 1000W heaters and 8 liters/min. pumping capacity. All parts contacting liquid are stainless steel.

For a closer look at the new Laudas, write for literature: Lauda Circulators, Division of Brinkmann Instruments, Inc., Cantiague Road, Westbury, N.Y. 11590. In Canada: Brinkmann Instruments (Canada), Ltd.

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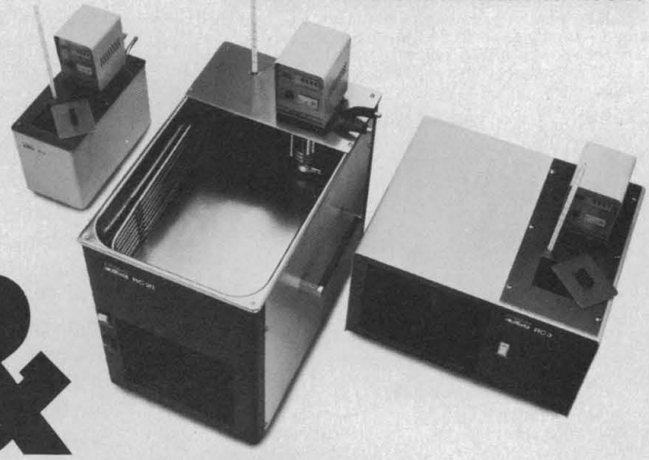
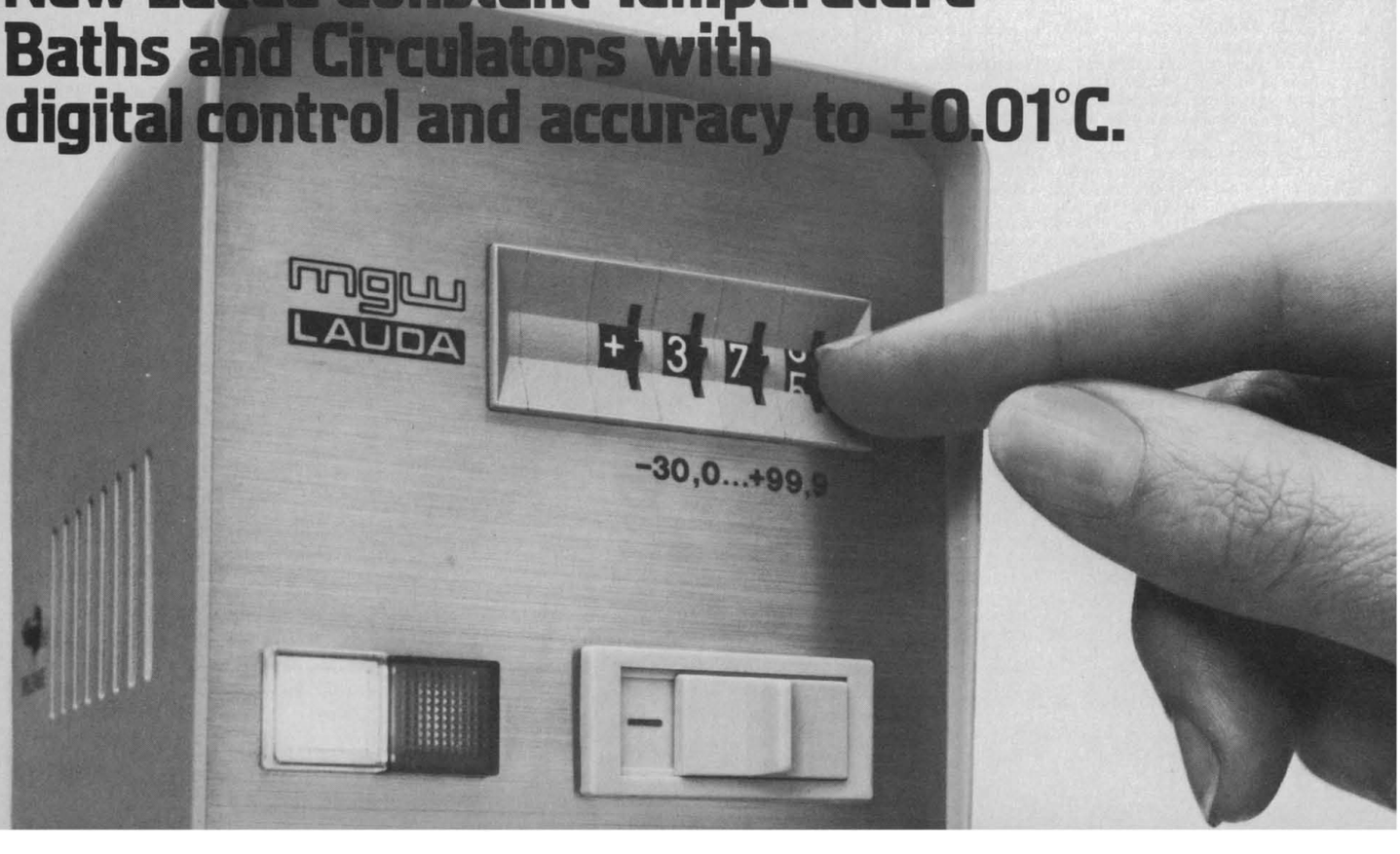
Lauda Circulators

Circle No. 22 on Readers' Service Card



SET IT & FORGET IT!

New Lauda Constant Temperature Baths and Circulators with digital control and accuracy to ±0.01°C.



PRODUCTS and MATERIALS

Programmable Sequencer

The EPC-7101 allows the operator to design his process as a sequence of steps and to enter his program directly via front-panel controls. The program may be made to run alternate sequences in response to input that may change as the program runs. Steps may be timed from 0.1 second up to 100 hours and as many as 999 steps may be entered. There are 32 outputs that are opto-isolated and provide onboard switching capacity of 250 milliamperes from 4 to 30 volts (d-c). Many laboratory experiments may be directly controlled by the EPC-7101. Encoder Products. Circle 764.

Gas Chromatograph

Model 511-23 is portable. The self-contained photoionization detector system is 10 to 30 times as sensitive for some compounds as a flame ionization detector with a sensitivity of 5 parts per billion for benzene. Because it has only one gas and because its supporting electronics are fully integral, the 511-23 is suitable for field analysis or for use in a laboratory. Analytical Instrument Development. Circle 765.

Microscope Photometer

The MVP compact is an accessory that converts a microscope into a microspectrophotometer. Thus, quantitative information may be extracted from microscopic images. The image of the mask which isolates the specimen structure to be measured, that structure, and the entire object field are viewed simultaneously. Electronically controlled shutters ensure that fading specimens are excited only during measurement and only for a selected time. Mercury, xenon, and tungsten-halogen lamps provide illumination. The electronics are housed in a small console with digital display and with BCD and analog data transfer ports. E. Leitz. Circle 766.

*p*H Meter

Model 501 offers digital display of *p*H from 0.00 through 14.00 with precision to ±0.01 unit. The device also reads out in millivolts. Temperature may be measured from −5° to 100°C within 0.1°C. Model 501 is delivered with an unbreakable platinum resistance probe which provides accurate automatic temperature compensation and digital reading of temperature and an unbreakable gel-filled electrode (95-01 GX) that does not require refilling with potassium chloride. Orion Research. Circle 768.

Sendai Vaccine

An estimated 85 percent of the world's laboratory mice are infected with Sendai virus. A killed-virus vaccine of chick-embryo origin is now available to eliminate the infection in breeder colonies and to protect existing colonies from the virus. This will reduce losses and, perhaps more important, it will eliminate subclinical infections which possibly affect interpretation of experimental results. Microbiological Associates. Circle 769.

Carboxylic Acid Analyzer

Model S-700 is equipped with an autosampler that can successively analyze up to 36 samples. The detection method is based on carboxyl groups and in principle the operation resembles that of amino acid analyzers. Carboxylic acids are separated by ion-exchange chromatography and detected by specific color reaction. Most sample solutions may be directly analyzed after insoluble materials are removed or after deproteinization. Carboxylic acids are detected down to 10 nanomoles. Analysis time is usually only 2 hours. Seishin Pharmaceutical. Circle 770.

Microanalytic Balance

Model 26 features expanded ranges that empower the direct weighing of a 50-milligram specimen to 0.001 milligram without mechanical taring or substitute weighing. The expanded ranges render sensitivity to 0.01 milligram for 500-milligram specimens and to 0.0001 milligram for 5-milligram specimens. There are five weighing ranges and electronic push-button tare offers 120 percent capacity in each of the ranges. Buffered BCD output permits interfacing with data storage and processing equipment. Cahn Instruments, Ventron. Circle 767.

Literature

Biochemicals fully defines an extensive line of products including their applications, prices, and relevant bibliographies. Miles Laboratories, Research Products Division. Circle 763.

Laboratory Furniture features the Adaptalab line that is designed for use in combination with flexible cabinetry or as conventional furniture. There are 46 basic cabinets and eight types of work surfaces available in five colors. Curtin Matheson Scientific. Circle 771.

Thermal Anemometry is the subject of a bibliography of over 1300 papers listed chronologically and alphabetically by author within each year. TSI. Circle 772.

Rotary Evaporator describes the Heidolph line for distillation and other analytic techniques. Wheaton Instruments. Circle 773.

Strip Chart Recorder is devoted to model ER-180, a 7-inch model for laboratory applications. Yokogawa. Circle 774.

Liquid Scintillation Cocktail describes Hydrofluor, a nonflammable material with a low rate of evaporation. National Diagnostics. Circle 775.

Radionuclide Spectroscopy introduces the Gamma Lab system of analytic apparatus for quantitative and qualitative determinations. EG & G Ortec. Circle 776.

Infrared Spectrometer is devoted to the MX-1 that offers the sensitivity, accuracy, and speed of Fourier-transform analysis at prices comparable to those of dispersive spectrometers. Nicolet Instrument. Circle 777.

Newly offered instrumentation, apparatus, and laboratory materials of interest to researchers in all disciplines in academic, industrial, and government organizations are featured in this space. Emphasis is given to purpose, chief characteristics, and availability of products and materials. Endorsement by *Science* or AAAS is not implied. Additional information may be obtained from the manufacturers or suppliers named by circling the appropriate number on the Readers' Service Card (on pages 218A and 290A) and placing it in the mailbox. Postage is free.
—RICHARD G. SOMMER