

29 February 1980 • Vol. 207 • No. 4434

\$1.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



RESEARCH & DEVELOPMENT

AAAS REPORT SERIES

Research and Development: AAAS Reports are a series of books aimed at promoting a clearer understanding of R&D funding and policy issues among the scientific, technological, and public policy communities and those responsible for policy and funding decisions on R&D.

• Now Available •

Research and Development: AAAS Report IV

AAAS Report IV, the most recent book in the series, addresses the budgetary and policy issues facing U. S. R&D issues which are shaping the scale and quality of U. S. science and technology. The initial sections of **AAAS Report IV** examine the R&D recommendations and policies associated with the President's FY 1980 budget. Additional sections update the data and policy outlook on R&D in industry and, in a further broadening of the scope of the R&D series, examine various international aspects of R&D and identify some of the key issues in the international arena. Prepared by Willis H. Shapley and Don I. Phillips. ISBN 0-87168-243-5; 1979, xviii + 141 pages, paperbound. \$6.50*

• Also Available •

Research & Development: AAAS Report III

AAAS Report III expands the scope of the series beyond federal R&D analysis to cover R&D in industry and a discussion of the impact of R&D on the U.S. economy. Prepared by Willis H. Shapley and Don I. Phillips. ISBN 0-87168-236-2; 1978, xiv + 122 pages, paperbound. \$5.00*

Research & Development in the Federal Budget: FY 1978

AAAS Report II takes a closer look at the congressional role in R&D budgeting and suggests a new conceptual basis for R&D budget decisions. Prepared by Willis H. Shapley, Don I. Phillips, and Herbert Roback. ISBN 0-87168-231-1; 1977, xii + 148 pages, paperbound. \$5.00*

Research & Development in the Federal Budget: FY 1977

AAAS Report I provides a detailed exposition of the federal budget process for R&D and of policy issues of continuing

concern to the R&D community. Prepared by Willis H. Shapley, ISBN 0-87168-228-1; 1976, ix + 100 pages, paperbound. \$5.00*

Research & Development Colloquium Proceedings

Proceedings from the annual colloquia on research and development contain the text of all speeches and in-depth summaries of the subsequent panel discussions. (Quantities are limited.)

R&D Colloquium Proceedings 1979, ca. 150 pgs., app., paper. (Companion volume to **AAAS Report IV**) available Sept. 1979. \$6.50*

R&D Colloquium Proceedings 1978, v + 178 pgs., app., paper. (Companion volume to **AAAS Report III**) \$5.00*

R&D Colloquium Proceedings 1977, v + 130 pgs., app., paper. (Companion volume to **AAAS Report II**) \$5.00*

R&D Colloquium Proceedings 1976, vi + 136 pgs., app., paper. (Companion volume to **AAAS Report I**) \$5.00*

To order your copy(s) of the above R&D Reports and Proceedings please fill in the coupon below and mail today. All orders under \$10.00 must be accompanied by remittance. AAAS Members discount honored on prepaid orders only.*

ORDER FORM — Please send me the following R&D Reports and Colloquium Proceedings:

_____ R&D Report IV, 1980	\$ 6.50	_____ Colloquium Proceedings 1979	\$ 6.50
_____ R&D Report III, 1979	\$ 5.00	_____ Colloquium Proceedings 1978	\$ 5.00
_____ R&D Report II, 1978	\$ 5.00	_____ Colloquium Proceedings 1977	\$ 5.00
_____ R&D Report I, 1977	\$ 5.00	_____ Colloquium Proceedings 1976	\$ 5.00
_____ All four R&D Reports	\$20.00	_____ All Four Proceedings	\$20.00
_____ The entire R&D Series (8 publications) — \$36.00			

Send R&D Reports and Proceedings to:

Name _____
 Address _____

Total amount of order \$ _____
 10% Member discount* \$ _____
☐ amount enclosed \$ _____
☐ amount to be billed \$ _____



Mail Order Form To:
 AAAS, Department L-1
 1515 Massachusetts Ave., N.W., Washington, D.C. 20005

*AAAS Members entitled to a 10% discount on prepaid orders only.
☐ Please send me information on additional AAAS publications
 Please allow 6-8 weeks for delivery of order

FOR TODAY'S FACULTY AND COLLEGE STAFF MEMBERS* FROM 18 TO 80.

Whether you're thinking retirement or not, review the plan that provides for cash withdrawal (without surrender charge) and/or a lifetime income.

TIAA-CREF Supplemental Retirement Annuities (SRAs) offer you substantial flexibility including cash withdrawal and/or lifetime retirement income. You can even reduce your income taxes now!

You can begin contributions to an SRA at any age and begin benefits at any age up to age 71 unless you are still employed (then you can delay beginning benefits until age 80). For example, you could start contributions at age 25, and choose to begin benefits or withdraw cash at age 34, 40 or 50, regardless of your employment status.

Get your money at any time.

You can receive benefits as a lifetime income or over a fixed period of from 2 to 10 years. What's more, if you need it (even while employed by your current employer), you can withdraw all the money you have accumulated by surrendering your contracts. Or, you can withdraw \$1,000 or more every six months. There is never a cash surrender charge.

Contributions are tax-deferred, so you pay less income taxes now.

The federal income tax on your contributions is deferred until they are paid to you as benefits. So, you pay less tax now.

Changing employers? Take SRAs with you.

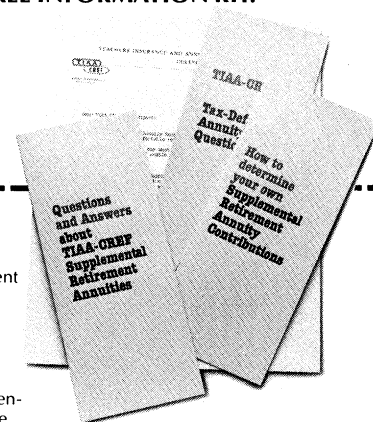
Since you own your Supplemental Retirement Annuities, you take them with you if you leave your current employer. You can make contributions through any institution that makes Supplemental Retirement Annuities available to staff members. Contributions can be as little as \$25 a month.

Full information.

Complete and mail the coupon for an SRA Information Kit today. You'll get full details about all the advantages SRAs have to offer, why this plan suits so many financial situations and age groups and how much you may contribute to the plan.

*TIAA-CREF provides annuities and other services for employees of colleges, universities, private schools and certain other nonprofit tax-exempt educational and research institutions.

HELP YOURSELF TO A BRIGHTER FINANCIAL FUTURE ...SEND FOR A FREE INFORMATION KIT.



Teachers Insurance and Annuity Association of America—College Retirement Equities Fund
730 Third Avenue
New York, N.Y. 10017

Please send me full details about TIAA-CREF Supplemental Retirement Annuities, the flexible tax-deferred annuity plan that offers the opportunity to accumulate funds for additional retirement income and the option for cash withdrawal.

Name _____

Address _____

City _____

State _____ Zip _____ Date of Birth _____

Name of Institution _____

Please let us know if you are participating in a TIAA-CREF retirement plan at your institution. ☐ YES ☐ NO

S-2-80

SCIENCE

LETTERS	History of Science: Perceptions: <i>C. C. Gillispie; R. E. Kohler;</i> Occupational Lead Exposure and Cancer: <i>H. K. Kang, P. F. Infante,</i> <i>J. S. Carra</i>	934
EDITORIAL	The Oil Price Spiral	937
ARTICLES	A Simple Description of the 3 K Cosmic Microwave Background: <i>P. S. Henry</i>	939
	Modeling the Climatic Response to Orbital Variations: <i>J. Imbrie</i> and <i>J. Z. Imbrie</i> . .	943
	DNA Gyrase and the Supercoiling of DNA: <i>N. R. Cozzarelli</i>	953
NEWS AND COMMENT	MX Faces Stiff Political Test in Nevada	961
	<i>Briefing:</i> Hazardous Wastes Cause International Stink: Science Groups Consider a Soviet Boycott: EPA Receives First Prod on Toxic Substances	962
	Museum and Patron at Odds over Sub	964
	Congress Moves to Relax Curbs on CIA	965
RESEARCH NEWS	Testing for Cancer Risk	967
	Genes and Cancer: The Story of Wilms Tumor	970
BOOK REVIEWS	Citation Indexing, reviewed by <i>R. McGinnis</i> ; Herbivores, <i>M. D. Rausher</i> ; The Properties of Diamond, <i>F. P. Bundy</i> ; The Soil-Root Interface, <i>W. R. Gardner</i> ; Books Received	972

BOARD OF DIRECTORS

KENNETH E. BOULDING
Retiring President, ChairmanFREDERICK MOSTELLER
PresidentD. ALLAN BROMLEY
President-ElectELOISE E. CLARK
MARTIN M. CUMMINGSRENEE C. FOX
NANCIE L. GONZALEZ

CHAIRMEN AND SECRETARIES OF AAS SECTIONS

MATHEMATICS (A)
Herbert B. Keller
Ronald GrahamPHYSICS (B)
William M. Fairbank
Rolf M. SinclairCHEMISTRY (C)
H. S. Gutowsky
William L. JollyASTRONOMY (D)
Tobias Owen
Donat G. WentzelPSYCHOLOGY (J)
Lloyd G. Humphreys
Meredith P. CrawfordSOCIAL AND ECONOMIC SCIENCES (K)
Kingsley Davis
Gillian LindtHISTORY AND PHILOSOPHY OF SCIENCE (L)
Brooke Hindle
Diana L. HallENGINEERING (M)
H. Norman Abramson
Donald E. MarloweEDUCATION (Q)
Joseph D. Novak
Roger G. OlstadDENTISTRY (R)
Robert J. Genco
Harold M. FullmerPHARMACEUTICAL SCIENCES (S)
David A. Knapp
Robert A. WileyINFORMATION, COMPUTING, AND COMMUNICATION (T)
Henry M. Kissman
Madeline M. Henderson

DIVISIONS

ALASKA DIVISION

E. Lee Gorsuch
PresidentT. Neil Davis
Executive Secretary

PACIFIC DIVISION

William L. Sims
PresidentAlan E. Leviton
Executive Director

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

Henry J. Shine
PresidentM. Michelle Balcomb
Executive Officer

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly**. Copyright © 1980 by the American Association for the Advancement of Science. Domestic individual membership and subscription (51 issues): \$34. Domestic institutional subscription (51 issues): \$70. Foreign postage extra: Canada \$12, other (surface mail) \$15, air-surface via Amsterdam \$40. First class, airmail, school-year, and student rates on request. Single copies \$1.50 (\$2 by mail); back issues \$2.50 (\$3 by mail); classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. **Postmaster:** Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORTS	Hektor: The Largest Highly Elongated Asteroid: <i>W. K. Hartmann</i> and <i>D. P. Cruikshank</i>	976
	Electron Spin Resonance Dating of Animal and Human Bones: <i>M. Ikeya</i> and <i>T. Miki</i>	977
	Isotopic Disequilibrium of Uranium: Alpha-Recoil Damage and Preferential Solution Effects: <i>R. L. Fleischer</i>	979
	Viscous Flow Circulation of the Solar Wind Behind Venus: <i>H. Pérez-de-Tejada</i>	981
	Nutrient and Oxygen Redistribution During a Spring Neap Tidal Cycle in a Temperate Estuary: <i>K. L. Webb</i> and <i>C. F. D'Elia</i>	983
	Inhibition of Cellular Proliferation of Imaginal Epidermal Cells by Diflubenzuron in Pupae of the Stable Fly: <i>S. M. Meola</i> and <i>R. T. Mayer</i>	985
	Phosphorus Sources for Aquatic Weeds: Water or Sediments?: <i>R. Carignan</i> and <i>J. Kalff</i>	987
	Carbon Dioxide Sensitivity in Mosquitoes Infected with Sigma, Vesicular Stomatitis, and Other Rhabdoviruses: <i>L. Rosen</i>	989
	Elevated Superoxide Dismutase in Black Alcoholics: <i>B. C. Del Villano</i> et al.	991
	Tooth Induction in Chick Epithelium: Expression of Quiescent Genes for Enamel Synthesis: <i>E. J. Kollar</i> and <i>C. Fisher</i>	993
	Tissue Specificity of Enzyme Expression Regulated by Diffusible Factors: Evidence in <i>Drosophila</i> Hybrids: <i>W. J. Dickinson</i>	995
	Chronic Arthritis in Goats Caused by a Retrovirus: <i>T. B. Crawford</i> et al.	997
	Genetic Differences in Physiological Tolerances of Amargosa Pupfish (<i>Cyprinodon nevadensis</i>) Populations: <i>M. F. Hirshfield</i> , <i>C. R. Feldmeth</i> , <i>D. L. Soltz</i>	999
	Temperature Sensitivity of Tone in the Rabbit Facial Vein: Myogenic Mechanism for Cranial Thermoregulation?: <i>R. J. Winkquist</i> and <i>J. A. Bevan</i>	1001
	High-Frequency Sensitivity in Infants: <i>B. Schneider</i> , <i>S. E. Trehub</i> , <i>D. Bull</i>	1003
	<i>Technical Comments:</i> Shark Skin and Locomotion: <i>C. W. McCutchen</i> ; <i>S. A. Wainwright</i> , <i>F. Vosburgh</i> , <i>J. H. Hebrank</i> ; Lateralized Cognitive Processes and the Electroencephalogram: <i>R. J. Davidson</i> and <i>H. Ehrlichman</i> ; <i>A. S. Gevins</i> et al.; Differential Killing of Normal and Cystic Fibrosis Fibroblasts by Dexamethasone: <i>J. L. Breslow</i> and <i>J. Epstein</i> ; Clomid Administration to Rats: <i>L. R. Malinak</i> , <i>R. H. Kaufman</i> , <i>H. J. Spjut</i> ; <i>J. H. Clark</i> and <i>S. H. McCormack</i>	1004

BOARD OF DIRECTORS

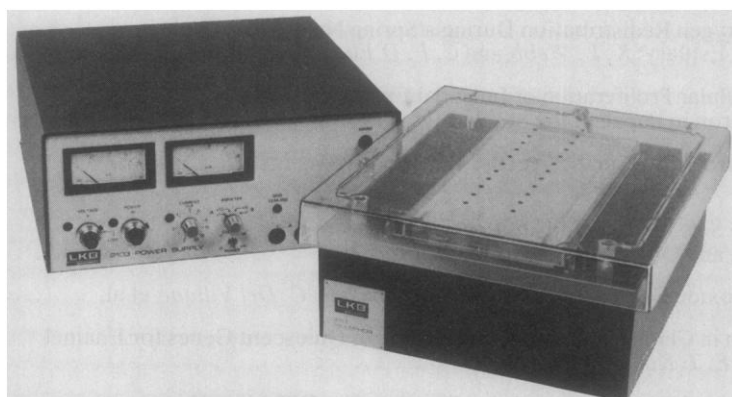
ANNA J. HARRISON RUSSELL W. PETERSON	JOHN C. SAWHILL HARRIET ZUCKERMAN	WILLIAM T. GOLDEN Treasurer	WILLIAM D. CAREY Executive Officer
GEOLOGY AND GEOGRAPHY (E) Doris Malkin Curtis Samon E. Bisque	BIOLOGICAL SCIENCES (G) Thomas Eisner Walter Chavin	ANTHROPOLOGY (H) Edward I. Fry Priscilla Reining	
MEDICAL SCIENCES (N) Philip K. Bondy Brian M. Lowenstein	AGRICULTURE (O) Roger L. Mitchell Coyt T. Wilson	INDUSTRIAL SCIENCE (P) John D. Caplan Robert L. Stern	
STATISTICS (U) Oscar Kempthorne Ezra Glaser	ATMOSPHERIC AND HYDROSPHERIC SCIENCES (W) Edward S. Epstein Glenn R. Hilst	GENERAL (X) Vera Kistiakowsky S. Fred Singer	

COVER

Nearly cloud-free view of Vatnajökull ice cap, which covers about 8400 square kilometers at 64°30'N along the southeastern coast of Iceland. Landsat image shows the extent of snow- and ice-free ground on 22 September 1973. See page 943. [R. S. Williams, Jr., U.S. Geological Survey, Reston, Virginia]

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

In the time it takes you to read this ad you could have loaded 20 samples onto your electrofocusing gel



That's how easy it is with LKB's Multiphor® unit. And duration of the runs is also short: the precisely engineered all-glass cooling stage means that you can apply higher power for faster runs—higher field strengths for sharper resolution. With the Multiphor unit and LKB's power supply you can do up to 48 samples in less than two hours!

Besides being the system of choice for analytical and preparative electrofocusing, the Multiphor unit is excellent for electrophoresis as well. Simply add the required kit and you're ready to work with SDS-polyacrylamide gels, agarose gels — even immunoelectrophoretic methods.

For safety the Multiphor unit is also unique. There is no metal in the cooling stage to invite short circuits, the electrode design makes it almost impossible to come into contact with high voltage, and the power supply has a safety interlock so you can connect it to your own equipment without additional risk.

If you think that a system which offers so much in speed, reproducibility, versatility and safety has to be costly, think again. The Multiphor system is one of the least expensive flat bed instruments available. Send for details today. (And be sure to ask for pertinent LKB Application Notes, a free subscription to *Acta Ampholinae* and information about forthcoming electrofocusing seminars and workshops.)



LKB Instruments Inc.
12221 Parklawn Drive Rockville, MD 20852
301: 881-2510

LETTERS

History of Science: Perceptions

Several statements in the report of my lecture on history of science at the AAAS annual meeting (News and Comment, 25 Jan., p. 389) require correction. A slip of memory evidently led me to call Otto Hahn's collaborator Strassner instead of Strassmann. More important, the organizer of the colloquium "Do scientists have blood on their hands?," who was not known to me, has since persuaded me that my perception of the tenor of the principal presentation was unduly affected by the provocative choice of words for the title from Robert Oppenheimer's famous statement to Truman.

The presentation was by a serious historian specializing in the political role of science in the early atomic age; and I was at fault in stating that no one present was knowledgeable about the technical aspects of nuclear weapons. Actually, several physicists and others knowledgeable about these issues were in the room, and it was inappropriate to cite the occasion to illustrate the proposition that judgments about the political morality of decisions to develop and employ atomic weapons have too often been uninformed with respect to the precise technical prospects at critical junctures.

The final point concerns the reporting of my lecture. I did not intend to leave the impression that personality has no place in the history of science. My view is the contrary, and I believe I observed that even scientists, when they take any interest at all in the history of science, are likely to fasten on minor matters of gossip or scandal instead of on content.

CHARLES C. GILLISPIE
*Program in History and Philosophy
of Science, Princeton University,
Princeton, New Jersey 08540*

One would never guess from Gillispie's lecture at the AAAS annual meeting or from William J. Broad's account of it that the history of science is in a period of intellectual excitement and growth unmatched since the 1930's. Historians of science are reaching out to new problems and methods. They are learning ways of analyzing the creative process and the diffusion of ideas as social processes. With historians of technology and medicine they are analyzing the two-way interaction between basic research and practice. Joined by recruits from general history and the social sciences, historians of science are finding wider audiences in these allied disciplines. Especially for those who, like myself,

came to history from careers in science, the past decade has been one of enormous intellectual refreshment and progress. The history of science is flourishing and growing in an otherwise depressed academic market.

Of what, then, is Gillispie complaining? He alleges that standards of scholarship are declining. I disagree. There are *different* standards now from those of a generation past; but not inferior standards—quite the contrary. There is just no question that standards of scholarship, sophistication in the use of archives, and standards of intellectual significance are much higher now than they were a decade ago; and they continue to improve, markedly among younger historians. The “decline of standards” is an old trick. A century ago the defenders of compulsory Greek cried “declining standards” to prevent the invasion of college curricula by the experimental sciences. This kind of argument may be good politics, but it is not good policy or good history.

Gillispie warns that the new historians of science are undermining the authority and public support of science by talking about scientist-entrepreneurs and scientist-politicians. I think the real danger is misplaced idealism. Can we really doubt in 1980 that the health of science depends on scientists' entrepreneurial and political skills? Is it wise to base public support for science on a false image of scientists as apolitical, isolated intellectuals and truth-seekers? To do so is to court disaster, for when the inevitable disillusionment comes it will indeed breed disrespect and cynicism. Historians and sociologists of science must contribute to an honest and realistic picture of the scientific enterprise as a social institution, not different in any fundamental way from other economic, cultural, or political institutions. To counsel historians to put scientists back in an imagined ivory tower is a great disservice both to the history of science and to science itself.

ROBERT E. KOHLER

*Department of History and Sociology
of Science, University of
Pennsylvania, Philadelphia 19104*

Occupational Lead Exposure and Cancer

Recent issues of *Science* have contained comments (1) on the role of occupational and environmental factors in cancer causation and of epidemiology in

identifying such associations. In light of this interest, we present here a reevaluation of data previously interpreted as supporting the noncarcinogenicity in humans of lead, one of the most ubiquitous substances in the environment.

In 1975, Cooper and Gaffey (2) reported on a cohort of 7032 men employed from 1946 through 1970 for one or more years in lead production facilities or battery plants. The stated objective of the study was to determine the mortality patterns of “individuals whose levels of lead absorption were below those associated with plumbism, but above those regarded as normal in the general population.” Data on actual airborne lead concentrations were reported not to be available. Employment histories of cohort members were obtained from company records. Vital status was determined through December 1970 for all but 2 percent of the smelter workers and 5 percent of the battery plant workers. For 18 smelter workers and 71 battery plant workers who had died, but for whom death certificates were not obtained, the distribution of individual causes of death was assumed to be the same as for individuals whose certificates had been obtained. Expected numbers of deaths were determined on the basis of rates from the U.S. male population. Standardized mortality ratios (SMR's) were calculated as 100 times the ratio of observed to expected deaths. Statistical significance of the SMR was determined by first calculating the standard error (S.E.) of each SMR with the technique developed by Chin Long Chiang (3). If an SMR deviated from 100 by more than

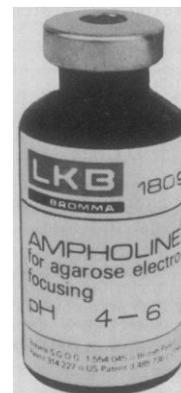
$$Z_{(1-\alpha/2)} \times \text{S.E.}$$

it was interpreted as significant at the 100 α percent level.

The SMR for all causes was 107 for smelter workers and 99 for battery workers. According to Cooper and Gaffey (2), deaths from all malignant neoplasms were excessive in smelter workers (69 observed versus 54.95 expected, $P < .05$), but not in battery plant workers (186 observed versus 180.34 expected). An excessive, although not statistically significant, number of deaths resulting from cancer of the digestive organs and of the respiratory system were reported among both smelter and battery plant workers.

In the study by Cooper and Gaffey it appears to us that there are errors in the way they determined statistical significance. First, according to Armitage (4) the formula for the S.E. of SMR should read $\text{S.E.} = \sqrt{100 \times \text{SMR}/\text{expected}}$, rather than $\text{S.E.} = 100 \times \text{SMR}/\text{expected}$,

Prepared by electrofocusing for electrofocusing



Ampholine® carrier ampholytes are prepared by electrofocusing a range of polyamino-polycarboxylic acids into nine narrow, specific pH fractions. Is there any better way to prepare materials used in a biochemical technique than by the very technique itself? We know of none.

Are you also aware that Ampholine carrier ampholytes have the sharpest and lowest MW range of any ampholytes on the market? And that *only* LKB's ampholytes have been shown to be easily separated from proteins with no artifactual binding? For the highest resolution, for the highest reliability, you can put your trust in Ampholine ampholytes.

Contact LKB today for full information on Ampholine solutions. Ask, too, about IEF workshops, seminars and a free subscription to *Acta Ampholinae*, a bibliography of over 2000 papers on IEF using Ampholine carrier ampholytes.

New: agarose for electrofocusing!

LKB

LKB Instruments Inc.

12221 Parklawn Drive Rockville, MD 20852
301: 881-2510

18A-303

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Editorial Board

1980: RICHARD E. BALZHISER, WALLACE S. BROECK-ER, CLEMENT L. MARKERT, FRANK W. PUTNAM, BRYANT W. ROSSITER, VERA C. RUBIN, MAXINE F. SINGER, PAUL E. WAGGONER, F. KARL WILLENBROCK

1981: PETER BELL, BRYCE CRAWFORD, JR., E. PETER GEIDUSCHEK, SALLY G. KOHLSTEDT, EMIL W. HAURY, MANCUR OLSON, PETER H. RAVEN, WILLIAM P. SLICHTER, FREDERIC G. WORDEN

Publisher

WILLIAM D. CAREY

Editor

PHILIP H. ABELSON

Managing Editor
ROBERT V. ORMES

Assistant Managing Editor
JOHN E. RINGLE

News Editor: BARBARA J. CULLITON

News and Comment: WILLIAM J. BROAD, LUTHER J. CARTER, CONSTANCE HOLDEN, ELIOT MARSHALL, DEBORAH SHAPLEY, R. JEFFREY SMITH, NICHOLAS WADE, JOHN WALSH. Editorial Assistant, SCHERRAINE MACK

Research News: BEVERLY KARPLUS HARTLINE, RICHARD A. KERR, GINA BARI KOLATA, JEAN L. MARX, THOMAS H. MAUGH II, ARTHUR L. ROBINSON. Editorial Assistant, FANNIE GROOM

Consulting Editor: ALLEN L. HAMMOND

Associate Editors: ELEANORE BUTZ, MARY DORFMAN, SYLVIA EBERHART, RUTH KULSTAD

Assistant Editors: CAITILIN GORDON, STEPHEN KEP-
PLE, LOIS SCHMITT

Book Reviews: KATHERINE LIVINGSTON, Editor;
LINDA HEISERMAN, JANET KEGG

Letters: CHRISTINE KARLIK

Copy Editor: ISABELLA BOULDIN

Production: NANCY HARTNAGEL, JOHN BAKER; YA LI SWIGART, HOLLY BISHOP, ELEANOR WARNER; MARY MCDANIEL, JEAN ROCKWOOD, LEAH RYAN, SHARON RYAN

Covers, Reprints, and Permissions: GRAYCE FINGER, Editor; CORRINE HARRIS, MARGARET LLOYD

Guide to Scientific Instruments: RICHARD G. SOMMER
Assistant to the Editor: JACK R. ALSIP

Membership Recruitment: GWENDOLYN HUDDLE

Member and Subscription Records: ANN RAGLAND

EDITORIAL CORRESPONDENCE: 1515 Massachu-
setts Ave., NW, Washington, D.C. 20005. Area code
202. General Editorial Office, 467-4350; Book Reviews,
467-4367; Guide to Scientific Instruments, 467-4480;
News and Comment, 467-4430; Reprints and Per-
missions, 467-4483; Research News, 467-4321. Cable:
Advancesci, Washington. For "Instructions for Contrib-
utors," write the editorial office or see page xi, *Science*,
21 December 1979.

BUSINESS CORRESPONDENCE: Area Code 202.
Membership and Subscriptions: 467-4417.

Advertising Representatives

Director: EARL J. SCHERAGO

Production Manager: GINA REILLY

Advertising Sales Manager: RICHARD L. CHARLES

Marketing Manager: HERBERT L. BURKLUND

Sales: NEW YORK, N.Y. 10036: Steve Hamburger, 1515
Broadway (212-730-1050); SCOTCH PLAINS, N.J. 07076:
C. Richard Callis, 12 Unami Lane (201-889-4873); CHI-
CAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Mich-
igan Ave. (312-337-4973); BEVERLY HILLS, CALIF.
90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-
2772); DORSET, VT. 05251: Fred W. Dieffenbach, Kent
Hill Rd. (802-867-5581).

ADVERTISING CORRESPONDENCE: Tenth floor,
1515 Broadway, New York, N.Y. 10036. Phone: 212-
730-1050.

The Oil Price Spiral

Recent events, coupled with those of the last several years, point toward three conclusions:

- Supplies of Middle Eastern oil are subject to sudden interruption.
- Excessive dependence on such oil invites World War III.
- The oil cartel could easily further sharply increase its revenues while cutting production.

Any one of these considerations should be sufficiently persuasive to induce the consuming nations to seek to limit dependence on imported oil. In practice, the most effective goad is likely to be high prices. Past experience indicates that the limit on what OPEC can charge has not yet been reached. A small shortfall of supplies can lead to a great increase in price. In 1973 and 1974, production of oil in the free world was cut by 10 percent. A quadrupling of the price of oil followed quickly. The revolution in Iran led to a decrease in production there, but increases elsewhere held the drop to about 5 percent. This shortfall gave rise to a doubling of the price of oil. Imports by the developed countries have been little affected by the doubling, although at the moment there is a softening of prices on the spot market.

It is obvious that OPEC could extract much more money from the consumers while extracting less oil from the earth. The questions become: When will the next major squeeze occur, and how high will the price go? Any estimate is a wild guess, but a further doubling could occur within a year.

Price increases might be avoided if demand for oil were curtailed substantially. For the short term, this could be achieved by drastic conservation in the developed countries—for example, by gasoline rationing—but at the moment meaningful conservation seems politically unfeasible. For the longer term, prospects for cutting the use of oil are better, and one can visualize how the price spiral might eventually be brought under control through conservation and by the development of renewable energy sources. For the intermediate term, the most feasible solution is enhanced substitution of coal for oil and natural gas.

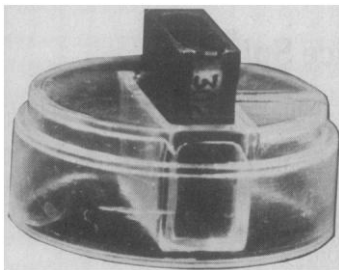
The energy potentially available in the form of coal is more than an order of magnitude greater than in oil. Important amounts of coal are present in many countries, including all the continents. Most important, the cost of thermal energy from coal is already substantially less than that from oil. In some parts of the world, the contrast is a factor of ten or more. Prospects for steadiness in the price of coal are good, and the large number of potential sources frees coal from the kind of political instability that now characterizes oil.

Quick substitution of coal is feasible in only a limited number of situations where oil had previously replaced coal. But the current contrasts in costs and uncertainties are serving as powerful incentives for exercise of ingenuity in adapting to coal. Action or lack of action by the United States will be an important factor in determining how fast substitution of coal will occur. More coal could readily be produced for both domestic and foreign consumption, but actions to implement the switch to coal have been slow.

Many foreign countries would like to obtain coal here, and delegations from France, West Germany, Japan, Spain, and Denmark have come to the United States during the last 2 months. However, concern has been expressed about the unreliability of supplies due to sudden domestic political moves and about the lack of infrastructure for experts. To make a really significant impact on world energy would require the existence of better rail transport, enlarged port facilities, and larger coal-carrying ships.

Switching toward use of coal will not be easy. However, new technology is being developed to improve the convenience and versatility of coal as a source of energy and chemicals. The United States can make many contributions to such developments. By moving resolutely this country could be crucial in helping to bring energy prices under control and in reducing dangerous tensions.—PHILIP H. ABELSON

IVIC DIAMOND KNIVES



MANUFACTURED BY SCIENTISTS FOR SCIENTISTS
QUALITY CONTROL WITH ELECTRON MICROSCOPE
ONLY THE PROVED USEFUL LENGTH OF THE KNIFE
IS CHARGED IN THE PRICE

USED BY SCIENTISTS ALL
OVER THE WORLD FOR MORE THAN 20 YEARS

FOR BROCHURE AND PRICE LIST WRITE TO
CENTRO TECNOLÓGICO - IVIC

Apartado 1827 - Caracas 101 - Venezuela
Telex: 21338 Caracas



2',3'-Dideoxynucleoside 5'-Triphosphates DNA Sequencing Reagents (Chain — Terminators)

- 4831** 2', 3'-Dideoxythymidine 5'-Triphosphate
 Pkg. Sizes and Prices:
 5 mg \$40.00 25 mg \$175.00
- 4823** 2', 3'-Dideoxycytidine 5'-Triphosphate
 Pkg. Sizes and Prices:
 4 μ moles . . . \$60.00 5x4 μ moles . . . \$275.00
- 4819** 2', 3'-Dideoxyadenosine 5'-Triphosphate
 Pkg. Sizes and Prices:
 4 μ moles . . . \$60.00 5x4 μ moles . . . \$275.00
- 4817** 2', 3'-Dideoxyguanosine 5'-Triphosphate
 Pkg. Sizes and Prices:
 4 μ moles . . . \$60.00 5x4 μ moles . . . \$275.00
- 4865** Dideoxynucleoside Triphosphate Kit
 One micromole of each of the four
 dideoxynucleoside triphosphates 1 Kit . . . \$80.00

Available from stock

excellence in biochemistry



PL biochemicals, inc.

1037 WEST MCKINLEY AVENUE, MILWAUKEE, WIS. 53205
 ® Call 414/347-7442 TWX 910-262-1111

The New York Academy of Sciences

announces a conference

THE THREE MILE ISLAND NUCLEAR ACCIDENT: LESSONS AND IMPLICATIONS

April 8-10, 1980

New York City

Roosevelt Hotel

The conference will examine the technical, social, and ethical implications of the accident at Three Mile Island in terms of the relationships of the institutions involved, the exchange of information among the public, the press, and the technical communities, and the long-term effects on the public acceptance of nuclear power.

Conference Chairs:

Thomas H. Moss
 Subcommittee on Science,
 Research, and Technology
 U.S. House of Representatives

David L. Sills
 Social Science Research Council
 New York City

For Program and Registration Information, Contact:

Conference Department, The New York Academy of Sciences,
 2 East 63rd Street, New York, NY 10021. (212) 838-0230.