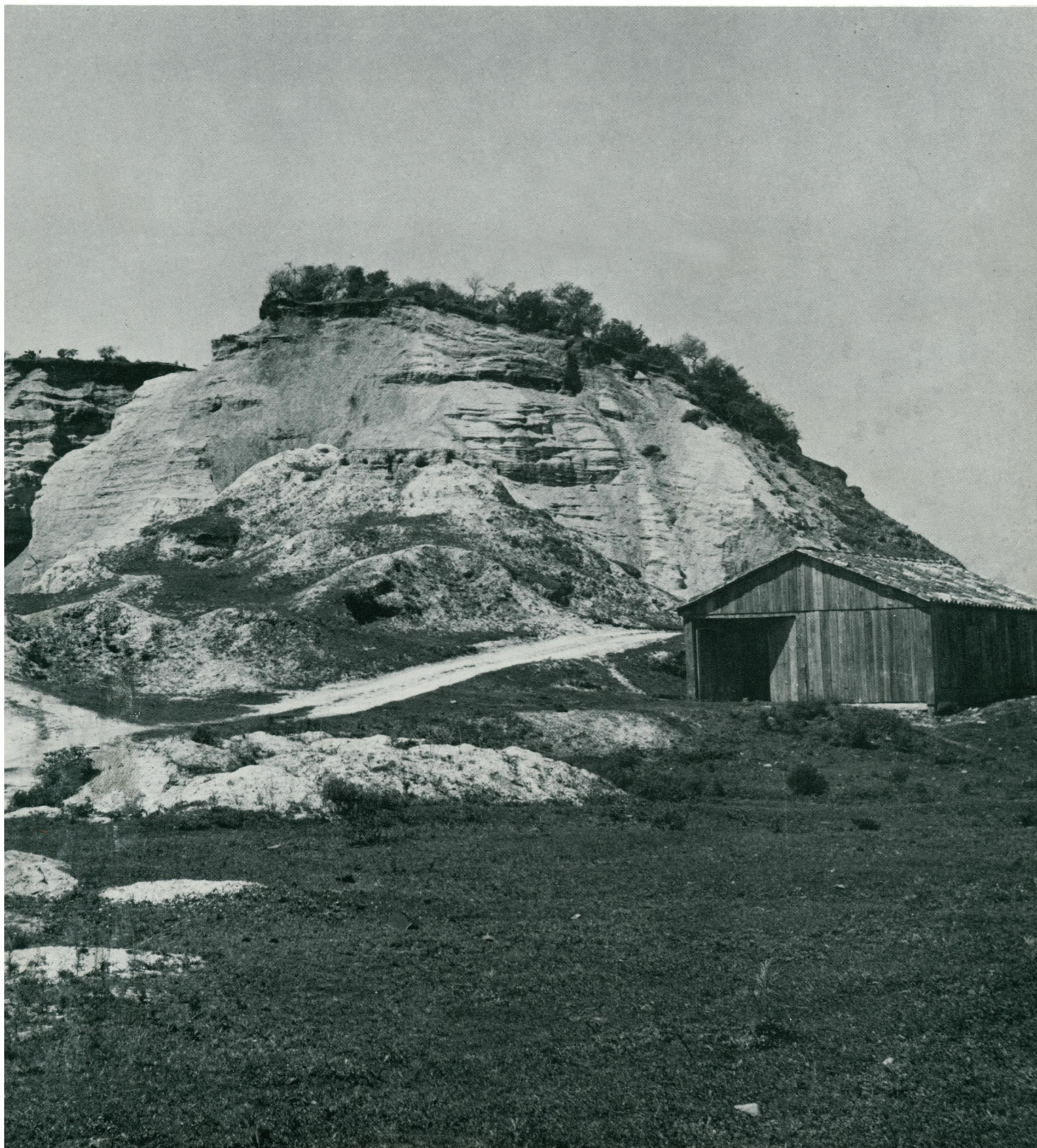


SCIENCE

30 January 1976

Volume 191, No. 4225

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



AUDIO



Selected Recordings on the Environment

For those concerned with the present and future status of our environment, AAAS offers an interesting and informative group of audiotapes on various aspects of environmental problems and policies. These high-quality recordings are intended not only for use in personal listening libraries but also in classroom or seminar-type settings. They are available from AAAS as 5-inch open reels or as cassettes. A complete listing of AAAS audiotapes is available on request, free of charge.

- | | |
|--|--|
| 59-70 Automobile Pollution (I) | 107-71 Interactions Between Natural and Urban Ecological Communities (I-II) |
| 67-70 Lake Restoration (I-II) | 110-71 Environmental Sciences and International Development (VII-VIII) |
| 73-70 Is Population Growth Responsible for the Environmental Crisis in the United States? (I) | 111-71 Heavy Metals as an Environmental Hazard to Fish, Birds, and Man (I-II) |
| 74-70 Reducing the Environmental Impact of a Growing Population (I-VI) | 113-71 Technology and Growth in a Resource-Limited World (I-II) |
| 82-70 Public Policy for the Environment | 128-72 The New Urban Vision (I) |
| 91-71 Indicators of Environmental Quality (I-VI) | 131-72 Temperate Climate Forestry and the Forest Ecosystem (I-II) |
| 92-71 Experimental Manipulations of Natural Systems (I-II) | 148M-73 Non-Nuclear Energy for Development (I-VI) |
| 101-71 The Energy Crisis: Some Implications and Alternatives (I-IV) | 175-74 Energy and Society (I-II) |
| 104-71 Environmental Noise (I-II) | 179-74 Fusion Power (I) |

[The hyphenated numbers preceding the symposium titles identify each title by tape number (preceding the dash) and by year of taping (after the dash). Roman numerals following the titles designate the number of sessions in each symposium.]

Prices: Single session symposium, \$19.95
Multi-sessions, \$19.95 for first session; \$16.95 for each additional session of the same symposium.
Approximate length of a single session is 3 hours.

Please send me the following tapes: (check one) _____reel _____cassette. (Allow 3 to 4 weeks for delivery.)

Tape No. _____ Session No. _____ Tape No. _____ Session No. _____

Tape No. _____ Session No. _____ Tape No. _____ Session No. _____

☐ Check or money order enclosed (payable to AAAS—no cash) ☐ Please bill me (subject to \$1.50 handling charge)

Name _____

Address _____

City _____ State _____ Zip Code _____

☐ Please send me a complete listing of AAAS audiotapes.



Department AT-8
AMERICAN ASSOCIATION for the ADVANCEMENT OF SCIENCE
1515 Massachusetts Avenue, N.W., Washington, D. C. 20005

Population: Dynamics, Ethics, and Policy



"A serious perusal of these papers, in all their variety, should lead to some very thought-provoking consideration of how an interdisciplinary and international approach might begin to give us a firmer grip on the problems of population balance . . ."

Margaret Mead, from the preface

These words bring into focus the unique contribution of *Population: Dynamics, Ethics, and Policy*, a new compendium of articles, research reports, and policy debates that originally appeared in *Science* during a 10-year time span beginning in 1966. Together these papers give you

- a close look at population research as conducted and reported by such American scientists as Bernard Berelson, Ansley Coale, Kingsley Davis, Garrett Hardin, Amos Hawley
- a glimpse at the continuing debate between those who advocate the dissemination of contraceptives and those who advocate more drastic methods of population control

But perhaps even more important, this compendium vividly reveals the ethnocentrism that has pervaded the American population debate.

If we want to solve the problems of population growth and control, we must recognize and deal with the extraordinary complexity of relationships between culture, nationhood, type of technological change, and ideological preoccupations . . .

If we want to go beyond where we are today, we must recognize and correct the defective theoretical basis on which national and international action has been taken for more than four decades . . .

If you want to know more about these and other aspects of population research and policy planning, be sure to read *Population: Dynamics, Ethics, and Policy*. Send for your copy today, available in your choice of casebound or paperbound editions. Preface by Margaret Mead. Edited and with an introduction by Priscilla Reining and Irene Tinker. Retail price \$12.95 casebound, \$4.95 paperbound; AAAS member price, prepaid \$11.95 casebound, \$4.45 paperbound.



ORDER FORM

Please send me **Population: Dynamics, Ethics, and Policy** (1975, viii + 184 pages):

_____ casebound copies. Retail \$12.95; AAAS member, prepaid, \$11.95. ISBN 0-87168-214-1.

_____ paperbound copies. Retail \$4.95; AAAS member, prepaid, \$4.45. ISBN 0-87168-225-7.

- ☐ Check or money order enclosed (payable to AAAS — no cash).
☐ Please bill me.

Name _____

Address _____

City _____

State _____ Zip _____

Send to Dept. PC

**AMERICAN ASSOCIATION
FOR THE ADVANCEMENT
OF SCIENCE**

1515 Massachusetts Avenue, N.W.
Washington, D.C. 20005

30 January 1976

Volume 191, No. 4225

SCIENCE

LETTERS	MIT Methanol Project: <i>D. C. White; J. P. Longwell; W. D. Compton; A. L. Hammond;</i> Gas Chromatographs: Health Effects: <i>M. S. Wolff, A. M. Langer, S. B. Shirey;</i> Grade Inflation: <i>H. C. Howland; J. J. Pear; K. K. Shearin; J. R. Warren;</i> Ozone Healing: <i>W. L. Chameides and J. C. G. Walker</i>	338
EDITORIAL	Science in the Public Forum: Keeping It Honest: <i>A. M. Weinberg</i>	341
ARTICLES	Predicting and Observing El Niño: <i>K. Wyrski et al.</i>	343
	Hydration Rate of Obsidian: <i>I. Friedman and W. Long.</i>	347
	Shellfish-Eating Preceramic Indians in Coastal Brazil: <i>R. W. Fairbridge</i>	353
NEWS AND COMMENT	Nuclear Energy: Do States Lack Power to Block Proliferation of Reactors?	360
	Ruckelshaus: What Happened to Mr. Clean?	361
	Projecting the Ph.D. Labor Market: NSF and BLS Disagree.	363
	Brigham Young University: An Alternative R & D Style	365
RESEARCH NEWS	European Breeders (II): The Nuclear Parts Are Not the Problem	368
	Protein Structure: Systematic Alteration of Amino Acid Sequences	373
ANNUAL MEETING	The Meeting Phenomenon: <i>A. Herschman</i>	374
BOOK REVIEWS	Growth Rhythms and the History of the Earth's Rotation, <i>reviewed by T. J. M. Schopf;</i> Isotopes in Organic Chemistry, <i>V. F. Raaen;</i> Nuclear Magnetic Resonance in Biochemistry, <i>R. K. Gupta;</i> Neural Integration of Physiological Mechanisms and Behaviour, <i>R. D. Myers;</i> Thinkers and Tinkers, <i>G. Basalla;</i> Books Received.	375

BOARD OF DIRECTORS

MARGARET MEAD
Retiring President, Chairman

WILLIAM D. MC ELROY
President

EMILIO Q. DADDARIO
President-Elect

RICHARD H. BOLT
KENNETH B. CLARK

JOEL COHEN
RUTH M. DAVIS

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS

MATHEMATICS (A)
Stanislaw M. Ulam
Truman A. Botts

PHYSICS (B)
Freeman J. Dyson
Rolf M. Sinclair

CHEMISTRY (C)
Henry A. Hill
Leo Schubert

ASTRONOMY (D)
Robert B. Leighton
Arlo U. Landolt

PSYCHOLOGY (J)
Wilbert J. McKeachie
Edwin P. Hollander

SOCIAL AND ECONOMIC SCIENCES (K)
William H. Sewell
Daniel Rich

HISTORY AND PHILOSOPHY OF SCIENCE (L)
Kenneth F. Schaffner
George Basalla

ENGINEERING (M)
Walter R. Hibbard, Jr.
Paul H. Robbins

EDUCATION (Q)
Mary Budd Rowe
James T. Robinson

DENTISTRY (R)
James K. Avery
Sholom Pearlman

PHARMACEUTICAL SCIENCES (S)
Joseph P. Buckley
Raymond Jang

INFORMATION, COMPUTING, AND COMMUNICATION (T)
Burton W. Adkinson
Joseph Becker

DIVISIONS

ALASKA DIVISION
Donald W. Hood
Chairman, Executive Committee

Keith B. Mather
Executive Secretary

PACIFIC DIVISION
Richard Walker
President

Alan E. Leviton
Secretary-Treasurer

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION
M. Michelle Baker
President

Max P. Dunford
Executive Officer

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with *The Scientific Monthly*. Second-class postage paid at Washington, D.C. and additional entry. Copyright ©1976 by the American Association for the Advancement of Science. Member rates on request. Annual subscription \$50; foreign postage: Americas \$7, overseas \$8, air lift to Europe \$30. Single copies \$2 (back issues \$3) except Food Issue (9 May 1975) is \$3 and *Guide to Scientific Instruments* is \$6. School year subscription: 9 months \$37.50; 10 months \$41.75. Provide 6 weeks notice for change of address, giving new and old address and zip codes. Send a recent address label. *Science* is indexed in the *Reader's Guide to Periodical Literature*.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORTS	Venus: Microwave Detection of Carbon Monoxide: <i>R. K. Kakar, J. W. Waters, W. J. Wilson</i>	379
	Protein Purification: Adsorption Chromatography on Controlled Pore Glass with the Use of Chaotropic Buffers: <i>H. G. Bock et al.</i>	380
	Crossbridge Attachment, Resistance to Stretch, and Viscoelasticity in Resting Mammalian Smooth Muscle: <i>M. J. Siegman et al.</i>	383
	Activation of Transplant Immunity: Effect of Donor Leukocytes on Thyroid Allograft Rejection: <i>D. W. Talmage et al.</i>	385
	Role of the Generative Cell in Androgenesis in Henbane: <i>V. Raghavan</i>	388
	Structure, Function, and Evolutionary Relationships of Fc Domains of Human Immunoglobulins A, G, M, and E: <i>T. L. K. Low, Y.-S. V. Liu, F. W. Putnam</i>	390
	Genetic Characteristics of the HeLa Cell: <i>S. H. Hsu et al.</i>	392
	Visual Adaptation: Effects of Externally Applied Retinal on the Light-Adapted, Isolated Skate Retina: <i>D. R. Pepperberg et al.</i>	394
	Habituation of Reflexes in <i>Aplysia</i> : Contribution of the Peripheral and Central Nervous Systems: <i>B. Peretz, J. W. Jacklet, K. Lukowiak</i>	396
	Apparent Modification of Forces Between Lecithin Bilayers: <i>D. M. LeNeveu et al.</i>	399
	Wheat Gluten as a Pathogenic Factor in Schizophrenia: <i>M. M. Singh and S. R. Kay</i>	401
	Intracellular Edema and Dehydration: Effects on Energy Metabolism in Alveolar Macrophages: <i>N. J. Lewiston, J. Theodore, E. D. Robin</i>	403
	Niche Shifts in Sunfishes: Experimental Evidence and Significance: <i>E. E. Werner and D. J. Hall</i>	404
	Panhandling: Sharing of Resources: <i>J. S. Lockard et al.</i>	406
	<i>Technical Comments: Pigeons Can Learn Identity or Difference, or Both: T. R. Zentall and D. E. Hogan; D. E. Carter and D. A. Eckerman; Exchange of Water During Lactation: M. I. Friedman and J. P. Bruno; P. Baverstock and B. Green</i>	408

MIKE MC CORMACK
FREDERICK MOSTELLER

CHAUNCEY STARR
CHEN NING YANG

WILLIAM T. GOLDEN
Treasurer

WILLIAM D. CAREY
Executive Officer

GEOLOGY AND GEOGRAPHY (E)
Helen L. Cannon
Ramon E. Bisque

MEDICAL SCIENCES (N)
Harold Wayland
Richard J. Johns

STATISTICS (U)
Emanuel Parzen
Ezra Glaser

BIOLOGICAL SCIENCES (G)
Edwin L. Cooper
Jane C. Kaltenbach

AGRICULTURE (O)
Orville G. Bentley
J. Lawrence Apple

ATMOSPHERIC AND HYDROSPHERIC
SCIENCES (W)
Fred D. White
Stanley A. Changnon, Jr.

ANTHROPOLOGY (H)
Daniel G. Mandelbaum
Philleo Nash

INDUSTRIAL SCIENCE (P)
Burton V. Dean
Robert L. Stern

GENERAL (X)
Gordon J. F. MacDonald
Joseph F. Coates

COVER

A typical early Indian midden (20 meters in height) at Carniça, near Laguna, Santa Catarina, Brazil. The midden is in the process of being quarried for agricultural lime. See page 353. [Wesley Hurt, Indiana University Museum, Bloomington, Indiana]

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 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. Postmaster: Send Form 3579 to SCIENCE, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.

Interested?
Curious?
Aware?



You should be receiving our MAN and MOLECULES audio cassettes!

Glenn Seaborg, Albert Ghiorso, Linus Pauling and other eminent scientists . . . in their own words and voices . . . bring you the answers to what you want to know in MAN and MOLECULES. As a subscriber to this remarkable service, you will receive a cassette carrying two of these enjoyable, understandable programs on current achievements and controversies in science—one on each side—every two weeks.

If at any time you are not satisfied with your MAN and MOLECULES subscription, just let us know. We'll stop delivery and refund the unused portion of your money.

Glance at the titles of some of the recent programs to see their special appeal.

- Foods for the Future
- Marijuana and Medicine
- The Menacing Mold
- Plants Against Cancer
- New Look for Car Engines
- The Polymer Switch
- The Dating Game
- Artificial Blood
- Nature's Lights
- Think Metric
- Copying Coral
- Jojoba Power

MAIL THE COUPON NOW!

Start listening to some of the world's most respected scientists, telling their own ideas in lively taped interviews. Enjoy these intriguing programs as often as you like in your office, library, classroom or home.

American Chemical Society
1155 Sixteenth St., N.W. Phone (202) 872-4446
Washington, D. C. 20036 ACS News Service

Please enter my subscription to MAN and MOLECULES on the following basis:

	20 Cassettes	25 Cassettes
ACS Members and Schools	<input type="checkbox"/> \$60.00	<input type="checkbox"/> \$75.00
Non-ACS	<input type="checkbox"/> \$70.00	<input type="checkbox"/> \$85.00

Overseas postage extra, air and surface rates on request.
☐ Check enclosed ☐ Bill me

Ship to: _____
Organization _____
Street _____
City _____
State _____ Zip _____

LETTERS

MIT Methanol Project

The article by Allen L. Hammond (News and Comment, 21 Nov. 1975, p. 761) states that the circumstances surrounding the termination of a fleet testing project on methanol at the Massachusetts Institute of Technology's Energy Laboratory were ambiguous, perhaps suspicious, because of our receipt of substantial funds from Exxon and the Ford Motor Company and because an Exxon employee (on leave, and at MIT as a visiting professor) was involved.

We at MIT unequivocally reject this and point out that Ford, Exxon, and the employee in question have no corporate or personal stand against the use of methanol. The crux of the question was whether the money would be used wisely.

Hammond's article is apt to lead—and in some instances has led—the casual reader to suspect that industry opposes methanol, that the use of methanol is in the best interests of the United States, and that hence something suspicious is indeed afoot. This we categorically reject and suggest that *Science* should uncover all the facts regarding methanol as a gasoline additive before giving such important publicity to the case of a disgruntled researcher.

DAVID C. WHITE

*Energy Laboratory,
Massachusetts Institute of Technology,
Cambridge 02139*

In Allen L. Hammond's article, "Methanol at MIT: Industry influence charged in project cancellation," my role in the development of methanol combustion research programs is represented as being predominantly negative. Since this is not the case, I would like to present my views on the potential of methanol as a fuel.

Methanol's outstanding combustion characteristics (no soot, efficient combustion over a wide range of fuel/air ratios, and high octane number) have been known for many years. When it became apparent that coal would become a major source of liquid fuels in the foreseeable future, I became involved in an assessment of the cost of producing fuels from coal by several methods (1). On a basis of cost per Btu, it appears that gasoline, Fischer-Tropsch liquids, and methanol produced from coal, while more expensive than current petroleum-based fuels, would be competitive with each other. The opportunity will therefore exist to exploit methanol's outstanding combustion characteristics when coal becomes a competitive liquid fuel source. Any of the coal-to-liquid fuel conversion processes, however, require a

very large investment and construction effort, and it is expected that major production for fuels will be accomplished before 10 to 15 years from now.

When methanol becomes available for use as a fuel, the first application might well be in existing peak power gas turbine installations when reduction of nitric oxide emissions is required, since substitution of methanol can result in a dramatic decrease (by a factor of 2 to 5) with minimum system modification.

The most spectacular gains, however, might well result from the use of methanol-water blends in automotive engines, where the superior lean combustion characteristics allow efficient operation with extremely low NO_x emissions, and the high octane number allows use of high compression ratios (2). Use of water allows low NO_x operation at high power densities. Understanding of combustion under these conditions and optimization of an automotive system for its use are, in my opinion, high priority research subjects.

Use of methanol blends in gasoline is technically feasible; however, it doesn't take full advantage of methanol's outstanding combustion characteristics and would, in my opinion, be a lower priority use than the above two.

Use of methanol is not limited by finding ways to use it so much as by economics and the timing for construction of production facilities. Fleet testing is most valuable as a last step in an application program and should be performed on an up-to-date car population to be relevant. In the meantime, there is a great deal of research and system optimization to be done.

J. P. LONGWELL

*940 Kimball Avenue,
Westfield, New Jersey 07090*

References

1. F. H. Kant, R. P. Cahn, A. R. Cunningham, M. H. Farmer, W. Herbst, E. H. Manny, *Feasibility Study of Alternative Fuels for Automotive Transportation* (Publication 235 582, National Technical Information Service, Springfield, Va., 1974).
2. W. J. Most and J. P. Longwell, "Single-cylinder engine evaluation of methanol-improved energy economy and reduced NO_x" (Preprint No. 750119, Society of Automotive Engineers, New York, 1975).

I feel obliged in my capacity as head of the Ford Motor Company's research staff and a member of the MIT Energy Laboratory Advisory Board to convey my chagrin over implications in the article by Allen L. Hammond concerning an MIT methanol project.

In commenting on the cancellation of a research project in which the use of methanol as a substitute for gasoline was being investigated at MIT's Energy Laboratory, Hammond cites the opinion of Thomas B. Reed, who initiated and led

the project, that "it was killed because the laboratory yielded to influence from the oil and automobile industries." After noting that the energy lab had been the recipient of two unrestricted grants from the Ford Motor Company Fund and from Exxon, Hammond states that "In addition, the laboratory's advisory board includes 7 oil and automobile industry people among its 24 members." He also addresses the question of "whether the energy lab's industry money and contacts have made it susceptible to influence." He concludes by noting that the "incident is troublesome because it raises the specter of universities adjusting their perspective as to what is important and their research programs to mesh more smoothly with government and industry."

These are serious charges that should not be casually accepted. Although Hammond does not comment directly on any Ford involvement, he notes that the grants received from Exxon and Ford "put the termination in an ambiguous, and perhaps suspicious, light." He does not mention that he talked with me by phone about these matters and that I assured him that I personally knew nothing of the energy lab's decision nor, to the best of my knowledge, had anyone else at Ford expressed any opinion to them about the fleet test, much less sought its cancellation.

I also provided Hammond with information about the extensive research on methanol-gasoline blends, pure methanol, and dual-fuel concepts of methanol and gasoline that has been conducted by the joint petroleum and automobile company Inter-Industry Emission Control Program, of which Ford is manager, and independently by Ford (1). While I noted that disadvantages exist with each of these systems, I told Hammond that I saw no unsolvable technical problems with them. Contrary to the view expressed by Reed, I believe the principal issue is economic, not political. Methanol will find a use as a fuel when the economics dictate it.

Hammond's article raises issues that go far beyond my own concern about the misleading implications and omissions I have mentioned, for it questions the propriety of industrial involvement in the academic world. Must universities be branded as handmaidens of industry when they seek and receive its financial support and know-how? Should the integrity of an eminent professor such as John Heywood be automatically questioned because he receives supplemental research support from industry? Is government support inherently more desirable than industry support? Are there to be no honest differences of opinion on technological and economic issues between the academic and industrial

worlds? What is the proper relationship of the university and industrial communities?

I believe these issues transcend the current controversy over the methanol experiment at MIT. They are issues that must be resolved if the university and industrial communities are to work together more effectively. I strongly urge *Science* to pursue these important issues more thoroughly—and fairly—than appears to have been the case in Hammond's article.

W. DALE COMPTON

Ford Motor Company,
20000 Rotunda Drive,
Dearborn, Michigan 48121

References

1. A. W. Crowley, J. P. Kubrick, M. Roberts, W. J. Koehl, W. L. Wascher, W. T. Watrung, in *Inter-Industry Emission Control Program-2 (IIEC-2), Progress Report No. 1* (Special Publication No. SP 395, Society of Automotive Engineers, New York, 1975), reprint No. 750419; J. A. Harrington and R. M. Pilot, in *ibid.*, reprint No. 750420; J. A. Harrington, in *Symposium on Future Automotive Fuels* (General Motors Research, Warren, Mich., in press).

There are obviously two points of view regarding the MIT Energy Laboratory's sensitivity to potential conflicts of interest and independence of judgment, both reflected in the article. White does not contest the facts. But it is worth pointing out that the subject of the article was the way in which the energy lab handled its industrial relationships, rather than the propriety of industrial involvement in the academic world or the scope of industrial methanol research. It is also relevant that representatives of oil and automobile companies have testified against the use of methanol-gasoline blends at federal and state legislative hearings.

—ALLEN L. HAMMOND

Gas Chromatographs: Health Effects

In response to inquiries about the potential health effects of using gas chromatographs insulated with asbestos, we have examined by light microscopy oven insulation from several gas chromatographs manufactured by five companies. Two instruments contained asbestos, either chrysotile or amosite, as woven tape or in block form. The remaining three brands of instruments were insulated with fibrous glass or rock wool. The asbestos block is compacted, but it is not sealed, so that dust can be generated from the surface. After temperature-programmed operations, when the oven lid shuts forcefully, or during maintenance and repair procedures, visible amounts of dust can be produced from these materials.

CHARLES C THOMAS • PUBLISHER

MAN IN THE COLD by Jacques LeBlanc, *Laval Univ., Quebec, Canada. Foreword by Charles G. Wilber.* This book relates the results obtained in recent years on laboratory animals exposed to cold and presents data accumulated on various human populations living in cold climates. A critical review is made of the nervous and endocrine control of substrate utilization at low temperature. Various types of adaptation with specific characteristics are emphasized in relation to different populations exposed to a variety of cold conditions. '75, 208 pp., 6 tables, \$15.50

PHYSICIAN'S HANDBOOK OF NUTRITIONAL SCIENCE by Roger J. Williams, *Univ. of Texas, Austin. Foreword by I. Newton Kugelmass.* The meaning of nutrition and its importance in medical practice is discussed in this book. Some of the topics considered are basic principles underlying nutritional science, internal nutrition, prenatal nutrition, biochemical individuality, and problems with environment and its effect on nutrition. '75, 126 pp., \$9.75

THE BIOLOGICAL AND CLINICAL BASIS OF RADIOSENSITIVITY edited by Milton Friedman, *Instituto Regina Elena, Rome, Italy. (35 Contributors)* To reduce the gap between laboratory and clinical schools, authorities from the fields of radiobiology, radiation pathology, preclinical radiobiology and experimental clinical radiotherapy are asked to relate their investigations to the common denominators of radiosensitivity and chemosensitivity. The pertinent is clarified, the unproven is defined, and irrelevant concepts are eliminated. '74, 592 pp. (7 x 10), 373 il., 67 tables, \$49.50

THE PLACENTA: Biological and Clinical Aspects edited by Kamran S. Moghissi and E. S. E. Hafez, *both of Wayne State Univ., Detroit, Michigan. (29 Contributors)* This volume is intended for scientists, clinicians and students of the placenta. Material presented includes modern biological and clinical aspects of the mammalian placenta and recent advances of the ultrastructure, endocrinology and metabolism of the human placenta. '74, 411 pp., 162 il., 30 tables, \$29.50

Prepaid orders sent postpaid, on approval

301-327 EAST LAWRENCE
SPRINGFIELD • ILLINOIS • 62717

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

1976

ALFRED E. BROWN	FRANK PRESS
JAMES F. CROW	FRANK W. PUTNAM
HANS LANDSBERG	MAXINE SINGER
EDWARD NEY	ARTHUR M. SQUIRES

1977

WARD GOODENOUGH	DONALD KENNEDY
CLIFFORD GROBSTEN	NEAL E. MILLER
H. S. GUTOWSKY	RAYMOND H. THOMPSON
N. BRUCE HANNAY	

Editorial Staff

Editor

PHILIP H. ABELSON

Publisher

WILLIAM D. CAREY

Business Manager

HANS NUSSBAUM

Managing Editor: ROBERT V. ORMES

Assistant Editors: ELLEN E. MURPHY, JOHN E. RINGLE

Assistant to the Editors: RICHARD SEMIKLOSE

News and Comment: JOHN WALSH, Editor; PHILIP M. BOFFEY, LUTHER J. CARTER, BARBARA J. CULLITON, CONSTANCE HOLDEN, DEBORAH SHAPLEY, NICHOLAS WADE. Editorial Assistant, SCHERRINE MACK

Research News: ALLEN L. HAMMOND, WILLIAM D. METZ, THOMAS H. MAUGH II, JEAN L. MARX, ARTHUR L. ROBINSON, GINA BARI KOLATA, FANNIE GROOM

Book Reviews: KATHERINE LIVINGSTON, LYNN MANFIELD, JANET KEGG

Cover Editor: GRAYCE FINGER

Editorial Assistants: JOHN BAKER, ISABELLA BOULDIN, MARGARET BURESCH, ELEANORE BUTZ, MARY DOREMAN, SYLVIA EBERHART, JUDITH GIVELBER, CAITILIN GORDON, CORRINE HARRIS, NANCY HARTNAGEL, OLIVER HEATWOLE, CHRISTINE KARLIK, MARGARET LLOYD, JEAN ROCKWOOD, LEAH RYAN, LOIS SCHMITT, YA LI SWIGART, ELEANOR WARNER

Guide to Scientific Instruments: RICHARD SOMMER

Membership Recruitment: GWENDOLYN HUDDLE; Subscription Records and Member Records: ANN RAGLAND

Advertising Staff

Director

EARL J. SCHERAGO

Production Manager

MARGARET STERLING

Advertising Sales Manager: RICHARD L. CHARLES

Sales: NEW YORK, N.Y. 10036: Herbert L. Burklund, 11 W. 42 St. (212-PE-6-1858); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 11 N. La Cienega Blvd. (213-657-2772); DORSET, VT. 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581)

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Phones: (Area code 202) Central Office: 467-4350; Book Reviews: 467-4367; Business Office: 467-4411; Circulation: 467-4417; Guide to Scientific Instruments: 467-4480; News and Comment: 467-4430; Reprints and Permissions: 467-4483; Research News: 467-4321; Reviewing: 467-4443. Cable: Advancesci., Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. See also page xi, *Science*, 26 September 1975. ADVERTISING CORRESPONDENCE: Room 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Science in the Public Forum: Keeping It Honest

The debate on most matters at the intersection of science and society is largely conducted in the public, not the scientific, forum. When scientists express opinions on scientific matters in the public forum they are not subject to the sanctions that regulate opinions expressed in the usual channels of scientific communication. Because these traditional sanctions do not operate, the extra-scientific debate often tends to be irresponsible scientifically: lower standards of proof are demanded in the public than in the professional debate, and half-truths are too often perpetrated on the public by scientists.

This tendency seems to me to be increasing. For example, in a recent article in a magazine devoted to science and public policy a physicist implied that nuclear weapons might detonate the atmosphere—when, in fact, this was shown to be a nonproblem some 25 years ago. Or consider the current debate on nuclear power. Two petitions, one pronuclear and the other antinuclear, were signed by scientists. Presumably, in signing the petitions, the scientists were implying that they possessed sufficient technical knowledge to make judgments on nuclear power. How many of the signers of either petition had studied nuclear power sufficiently to have a responsible scientific opinion on this complex issue?

A plea for greater responsibility on the part of scientists when they engage in scientific debate in the public forum poses serious practical, even epistemological questions. How can one know, when two scientists disagree on a scientific matter, whether it is because the issue is really beyond the proficiency of science or because one scientist has investigated the matter more thoroughly than the other? Some scientific issues can be unequivocally answered by science; others, perhaps most that are at the junction between science and policy, cannot—either because science has not progressed sufficiently (as in the debate on depletion of the ozone layer) or because the issues are unanswerable *in principle* (as may be the case with respect to long-term prediction of climatic changes). It seems to me that the scientist must be beyond reproach in doing his homework thoroughly whenever he makes scientific judgments, and he must delineate as sharply as possible where science ends and what I call trans-science begins. If this makes for fewer one-armed scientists and more scientists who say "I don't know," this is a hardship that Senator Muskie (who seeks more scientists willing to speak with certainty) simply must accept.

It is sometimes suggested that when scientists participate in nonscientific debates in which they claim special expertise, their obligation to speak responsibly is no greater or lesser than that of a lawyer or a politician. But science *is* special because, unlike law or politics, it deals with verifiable knowledge. Scientific methods of arriving at the best approximations to truth are known and tested. If scientists allow themselves the right to speak sloppily on science in the public forum, I think that this habit could gradually encroach upon the scientific forum.

Can we imagine mechanisms for injecting more responsibility into the scientific debate when it is conducted outside the scientific forum? Several suggestions have been made. For example, Arthur Kantrowitz has proposed a quasi-judicial scientific body that would conduct inquiries into conflicting scientific claims. The Operations Research Society of America, a few years ago, established a special panel to investigate contradictory technical assertions made by scientists in the debate on deployment of antiballistic missiles. Committees on ethics now exist within many professional societies. Should similar committees be set up by scientific societies?

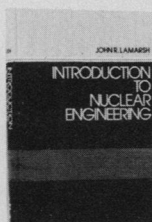
The AAAS is a natural focus for these concerns. I would hope that the officers and members of the AAAS could exchange ideas on how to make the scientific debate in the public forum more responsible. Out of such an exchange might come better mechanisms for keeping our science honest, even when it is not subject to the usual sanctions of the scientific community.—ALVIN M. WEINBERG, Director, Institute for Energy Analysis, Post Office Box 117, Oak Ridge, Tennessee 37830

Satisfy Your Need to Know

Outstanding Resource Books for Your Personal and Professional Library from Addison-Wesley

Which books are for you?

"A very well written book by an accomplished author. This book could be utilized by virtually anyone associated with the nuclear industry." — Craig E. Davies, Bettis Reactor Engineering School



Introduction to Nuclear Engineering

By John R. Lamarsh,
Polytechnic Institute of New York

Expert coverage of the nuclear field with an emphasis on nuclear power plants. You'll discover the most recent nuclear data as you explore reactor types, reactor criticality, reactor safety, heat removal, the effects of radiation and shielding, and the environmental effects of nuclear power. 626 pages, \$17.95

The Contents: The scope of nuclear engineering. Atomic and nuclear physics. Interaction of radiation with matter. Nuclear reactors and nuclear power. Neutron diffusion and moderation. Nuclear reactor theory. The time-dependent factor. Heat Removal from nuclear reactors. Radiation protection. Radiation shielding. Reactor safety and radioactive effluents in the environment.

"An excellent reference, it covers all the major aspects of the subject and on a high scientific level." — C. R. Gatz, Portland State University



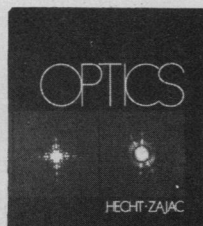
Fundamentals of Air Pollution

By Samuel J. Williamson,
New York University

Drawing on the fields of psychology, medicine, chemistry, physics, engineering, and the atmospheric sciences, this book relates the causes, evolution and effects of air pollution. Not a "clean air crusade," but a balanced scientific view of what is currently known on the subject. 472 pages, \$15.95

The Contents: Introduction. Some adverse effects. The atmosphere. Energy balance of the earth. Macroscale circulation. Meso- and micrometeorology. Effluent dispersal. Sulfurous smog. Stationary sources and their control. Photochemical smog. Motor vehicle controls. Aerosols. Ambient and emission standards. Pollution control strategies. Appendices. Questions. Problems.

"May well become a classic. It is stimulating, comprehensive, and of lasting value." — M. E. Mickelson, Denison University



Optics

By Eugene Hecht and Alfred Zajac,
Adelphi University

Filled with excellent diagrams and illustrations (602 in all), Hecht and Zajac's highly acclaimed OPTICS offers you a thorough, detailed study of both the traditional topics and modern developments such as multilayered thin films, fiber optics, spatial filtering, transfer functions, quantum optics, nonlinear optics, modulation, and holography. 572 pages, \$17.95

The Contents: A brief history. The mathematics of wave motion. Electromagnetic theory, photons, and light. The propagation of light. Geometrical optics-paraxial theory. More on geometrical optics. The superposition of waves. Polarization. Interference. Diffraction. Fourier optics. Basics of coherence theory. Some aspects of the quantum nature of light. Sundry topics from contemporary optics.

"Excellent — succinctly but completely covers the field." — Wilbur R. Enns, University of Missouri



Biological Systematics

By Herbert H. Ross, University of Georgia

Here is your clearly-written, cohesive guide to the principles and practices of modern systematics for both plants and animals. Covers investigation of systematic problems, the biological processes of speciation, phylogeny, pathways of ecological diversification, and much more. 345 pages, \$13.95

The Contents: Systematics and its development. Investigating systematic problems. The material basis of systematics. Scientific reasoning in systematics. The biological processes of speciation. The interpretation of contemporary species. Phylogeny. Fossils and time. Geographic dispersal. Pathways of ecological diversification. Classification. The future of systematics.

Mail Order Department • ADDISON-WESLEY PUBLISHING COMPANY, INC. • Reading, Massachusetts 01867

Make your selections and mail this order form today.

15-Day Free Examination Order

- ☐ Please send me the book(s) I've checked below to examine free for 15 days. I understand that if I am not completely satisfied, I may return the book(s) within 15 days for a full and prompt refund.
- ☐ A check for \$ _____ is enclosed (residents of Calif., Ga., La., Mass., Ind., N.C. and N.Y. add sales tax).
- ☐ Please bill to my: ☐ Master Charge, ☐ BankAmericard
Number _____ . Expiration date _____
For Master Charge, include first four digits above name _____

mail to: Mail Order Department
Addison-Wesley Publishing Company, Inc.
Reading, Massachusetts 01867

- ☐ **Introduction to Nuclear Engineering 4160** by Lamarsh \$17.95
- ☐ **Optics 2835** by Hecht and Zajac \$17.95
- ☐ **Fundamentals of Air Pollution 8629** by Williamson \$15.95
- ☐ **Biological Systematics 6531** by Ross \$13.95

Name _____

Address _____

City _____

State _____ Zip _____

12400