

SCIENCE

4 May 1973

Vol. 180, No. 4085

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



CUT IT OUT!

FOR ANY TYPE OF GRADIENT — that is all you have to do when you program the LKB ULTROGRAD® gradient mixer. A pair of scissors is all you need to cut the gradient profile for exactly the type of gradient you require. Our technician has just cut three, and he now indicates that he will use the one in the scanning window. When he has set the scanning rate and the duration of the run, he will

switch on and the ULTROGRAD will take over— automatically producing the gradient. He can program any type of gradient you like to name, from as many as three liquids at once.

With an optional level sensor, you can also monitor absorbance levels in an eluate and automatically vary the gradient, to provide greater separation of eluted components.

LKB

LKB Instruments Inc.

12221 Parklawn Drive, Rockville MD. 20852
11744 Wilshire Blvd. Los Angeles Calif. 90025
6600 West Irving Park Road, Chicago Ill. 60634
260 North Broadway, Hicksville N.Y. 11801

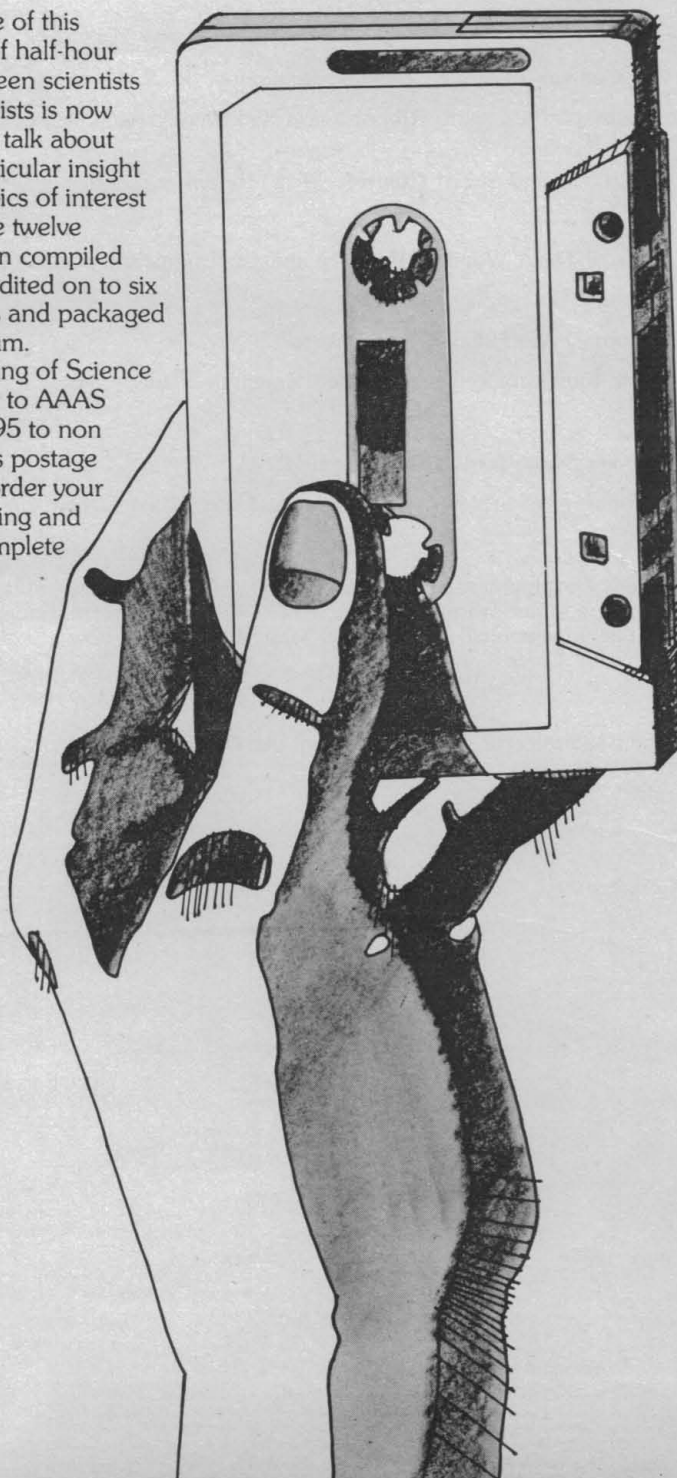


Speaking of Science

Volume 2

The second volume of this informative series of half-hour conversations between scientists and science journalists is now available. Scientists talk about their work with particular insight into a variety of topics of interest and concern. These twelve dialogues have been compiled by the AAAS and edited on to six audiotape cassettes and packaged in an attractive album.

The price of Speaking of Science Volume 2 is \$34.95 to AAAS members and \$39.95 to non members (both plus postage and handling). To order your copy of this interesting and exciting volume complete the order blank.



1. The Dilemma of Prisons, Dr. John P. Conrad, Dr. Edith E. Flynn, Mr. J.D. "Sonny" Wells with William Hines
2. Science and Sociology of Weather Modification, Dr. J. Eugene Haas, Dr. Thomas F. Malone with Peter Calamai
3. New Dimensions in Human Genetics, Dr. Leon E. Rosenberg, Dr. Michael M. Kaback, with Barbara J. Culliton
4. Children and Environment: A New View, Dr. Jerome Kagan with Judy Randal and Edward Edelson
5. Energy Rationing, Dr. Earl Cook, Dr. Samuel Z. Klausner with William Hines
6. Forest Ecology and Management, Dr. Gene Likens, Dr. Arnold W. Bolle with Edward Edelson
7. Environment and Cancer, Dr. C.S. Muir, Dr. Marvin Schneideman with Edward Edelson
8. Patterns of Discovery, Dr. Benjamin Bederson, Dr. John K. Hulm with Edward Edelson
9. The Limits of Growth: A Debate, Dr. Dennis Meadows, Dr. S. Fred Singer with David Perlman
10. Tragedy of the Commons Revisited, Dr. Garrett Hardin with Richard D. Lyons and Edward Edelson
11. Understanding Perception, Dr. Richard L. Gregory with Edward Edelson and Barbara J. Culliton
12. Exploring the Universe, Dr. Halton Arp, Dr. Herbert Friedman with Allen L. Hammond

Please send me _____ albums of Speaking of Science Volume 2 at \$39.95 each, \$34.95 for AAAS members. (both plus \$1.50 postage and handling).

_____ check enclosed _____ please bill me

name (please print)

address

city, state & zip

**American Association
For the Advancement
of Science**

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

4 May 1973

Volume 180, No. 408:

SCIENCE

LETTERS	Energy Supply: <i>S. P. Potter</i> ; Jason and the National Defense: <i>A. A. Broyles</i> ; <i>C. Schwartz</i> and <i>M. Brown</i> ; Coffee-Easies and Bacon-Pushers: <i>F. J. Little, Jr.</i> ; Research Planning: <i>U. V. Henderson, Jr.</i> ; <i>B. R. Stein</i> ; <i>D. Stetten, Jr.</i>	446
EDITORIAL	Spain—Another Japan?	449
ARTICLES	Use of Lasers to Control Selective Chemical Reactions: <i>V. S. Letokhov</i>	451
	Chemical Structures of Pancreatic Ribonuclease and Deoxyribonuclease: <i>S. Moore</i> and <i>W. H. Stein</i>	458
	Technology Assessment and Social Control: <i>M. S. Baram</i>	465
NEWS AND COMMENT	Agriculture: Signs of Dead Wood in Forestry and Environmental Research	474
	New Energy Message Downplays R & D	475
	British Science Policy: After the "Great Debate"	477
	NASA Seeks New Funds to Replace Crashed Research Plane	478
RESEARCH NEWS	Restriction Enzymes: New Tools for Studying DNA	482
	Holography: Beginnings of a New Art Form or at Least of an Advertising Bonanza	484
BOOK REVIEWS	The Polaris System Development, reviewed by <i>J. D. Steinbruner</i> ; Hepatitis-Associated Antigen and Viruses, <i>R. W. McCollum</i> ; Venezuelan Encephalitis, <i>J. P. Fox</i> ; The Biochemical Genetics of Man, <i>L. E. Rosenberg</i> ; Evolutionary Biology, <i>L. Van Valen</i>	486
REPORTS	Iodine-129/Xenon-129 Age of Magnetite from the Orgueil Meteorite: <i>G. F. Herzog et al.</i>	489

BOARD OF DIRECTORS

GLENN T. SEABORG
Retiring President, Chairman

LEONARD M. RIESER
President

ROGER REVELLE
President-Elect

RICHARD H. BOLT
LEWIS M. BRANSCOMB

BARRY COMMONER
EMILIO Q. DADDARIO

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS

MATHEMATICS (A)
Lipman Bers
F. A. Ficken

PHYSICS (B)
Edwin M. McMillan
Rolf M. Sinclair

CHEMISTRY (C)
Thomas E. Taylor
Leo Schubert

ASTRONOMY (D)
Frank D. Drake
Arlo U. Landolt

PSYCHOLOGY (J)
Carl P. Duncan
William D. Garvey

SOCIAL AND ECONOMIC SCIENCES (K)
Robert K. Merton
Harvey Sapolsky

HISTORY AND PHILOSOPHY OF SCIENCE (L)
Ernest Nagel
Dudley Shapere

INDUSTRIAL SCIENCE (P)
Jacob E. Goldman
Jordan D. Lewis

EDUCATION (Q)
Gordon Swanson
Phillip R. Fordyce

DENTISTRY (R)
Martin Cattoni
Sholom Pearlman

PHARMACEUTICAL SCIENCES (S)
William Heller
John Autian

DIVISIONS

ALASKA DIVISION

Gunter E. Weller
President
Irma Duncan
Executive Secretary

PACIFIC DIVISION

John D. Isaacs
President
Robert T. Orr
Secretary-Treasurer

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

J. Linton Gardner
President
Marlowe G. Anderson
Executive Secretary

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. Copyright © 1973 by the American Association for the Advancement of Science. Member rates on request. Annual subscription \$30; foreign postage: Americas \$4, overseas \$6, air lift to Europe \$18. Single copies \$1 (back issues, \$2) except *Guide to Scientific Instruments* which is \$4. School year subscriptions: 9 months \$22.50; 10 months \$25. Provide 4 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

Glaciers and Nutrients in Arctic Seas: <i>S. Apollonio</i>	491
Volcanic Production Rates: Comparison of Oceanic Ridges, Islands, and the Columbia Plateau Basalts: <i>A. K. Baksi</i> and <i>N. D. Watkins</i>	493
Detritus in Lake Tahoe: Structural Modification by Attached Microflora: <i>H. W. Paerl</i>	496
Circadian Rhythms in <i>Neurospora</i> : Spatial Differences in Pyridine Nucleotide Levels: <i>S. Brody</i> and <i>S. Harris</i>	498
Leukemia Virus Activation during Homograft Rejection: <i>M. S. Hirsch</i> et al.	500
Arrested Development in Human Hookworm Infections: An Adaptation to a Seasonally Unfavorable External Environment: <i>G. A. Schad</i> et al.	502
<i>Acanthaster</i> : Effect on Coral Reef in Panama: <i>P. W. Glynn</i>	504
Nerve Growth Factor: Enhanced Recovery of Feeding after Hypothalamic Damage: <i>B. D. Berger</i> , <i>C. D. Wise</i> , <i>L. Stein</i>	506
Neuronal Locus Specificity: Altered Pattern of Spatial Deployment in Fused Fragments of Embryonic <i>Xenopus</i> Eyes: <i>R. K. Hunt</i> and <i>M. Jacobson</i>	509
Brain Aluminum Distribution in Alzheimer's Disease and Experimental Neurofibrillary Degeneration: <i>D. R. Crapper</i> , <i>S. S. Krishnan</i> , <i>A. J. Dalton</i>	511
Heart Activity and High-Pressure Circulation in Cirripedia: <i>H. J. Fyhn</i> , <i>J. A. Petersen</i> , <i>K. Johansen</i>	513
Technical Comments: Photosynthesis and Atmospheric Oxygen: <i>P. Enos</i> ; <i>L. Van Valen</i> ; Origin of Mitochondria: <i>T. Uzzell</i> and <i>C. Spolsky</i> ; <i>R. A. Raff</i> and <i>H. R. Mahler</i> ..	515
AAAS/CONACYT MEETING Ecology and Deterioration of the Environment: <i>N. L. Richards</i> ; Tourist Card Information and Travel Regulations for Mexico City	518

WARD H. GOODENOUGH
CARYL P. HASKINS

DANIEL P. MOYNIHAN
PHYLLIS V. PARKINS

WILLIAM T. GOLDEN
Treasurer

WILLIAM BEVAN
Executive Officer

GEOLOGY AND GEOGRAPHY (E)

Helmut Landsberg
Ramon E. Bisque

ENGINEERING (M)

Raynor L. Duncombe
C. Towner French

INFORMATION AND COMMUNICATION (T)

Jordan Baruch
Scott Adams

BIOLOGICAL SCIENCES (G)

Dorothy Bliss
Richard J. Goss

MEDICAL SCIENCES (N)

Robert A. Good
F. Douglas Lawrason

STATISTICS (U)

Frederick Mosteller
Ezra Glaser

ANTHROPOLOGY (H)

Richard N. Adams
Anthony Leeds

AGRICULTURE (O)

Roy L. Lovvorn
Michael A. Farrell

ATMOSPHERIC AND HYDROSPHERIC SCIENCES (W)

Max A. Kohler
Louis J. Battan

COVER

Vertical air photograph of the northern end of South Cape Fiord, Ellesmere Island, Northwest Territories, showing three glaciers entering the fiord. See page 493. [Photo No. A-16722-10, courtesy National Air Photo Library, Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa, Canada]

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.

COLD POWER

SAVANT RECIRCULATING WATER COOLERS



The ONLY
way to
dissipate
LARGE HEAT
LOADS!

FLOOR MODEL—RWC-50
1½ H.P. or 4500 BTU
Price: \$990.00

DON'T WASTE WATER DOWN THE DRAIN!
Recirculate and control temperature at the same time.

One part of a dependable instrumentation system for the following equipment:

- High Voltage Electrophoresis
- Column Chromatography
- Ultracentrifuges
- Electron Microscopes

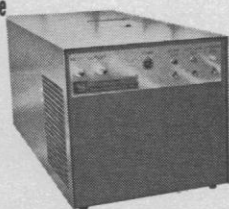


TABLE TOP MODEL—RWC-25
¼ H.P. or 1500 BTU
Price: \$725.00

CHECK THESE FEATURES: Noise-free positive displacement pump • Compact, modern designs...no exposed operating components • Completely mobile, easily moved to area where most needed. **DON'T WASTE WATER DOWN THE DRAIN...** write for detailed instrument literature #RWC.



Savant Instruments, Inc.

221 Park Avenue • Hicksville, New York 11801

(516) 935-8774

LETTERS

Energy Supply

The problem of the present widening gap between available energy reserves and increased energy use is one of critical concern to all of us. As Philip Abelson points out (Editorial, 2 Mar., p. 857), "we cannot afford the luxury of sleeping for another 12 years."

There are two points raised in the editorial, however, that I would like to comment on, as they recur often in discussions of the petroleum industry. One is the idea of "windfall profits." Crude oil prices, over the last decade, remained remarkably more stable than prices in general and more stable than costs to the industry itself for equipment and personnel. During this period the price of crude oil rose 17.2 percent, from \$2.90 a barrel to \$3.40 a barrel. The U.S. Bureau of Labor Statistics wholesale price index rose 25.6 percent for all commodities over the same period. During these years, oil well casing prices rose 45.9 percent, oil field machinery prices went up 35.7 percent, and average hourly wages in oil and gas production climbed by over 57 percent. Over the past 10 years (1962–1971), the petroleum industry's rate of return on net worth has averaged 11.8 percent, compared to an average of 12.2 percent for all manufacturing industries, according to surveys reported annually in the April issue of the First National City Bank of New York's *Monthly Economic Letter*.

If taxes are excluded, the price of gasoline, the industry's most consumer-visible commodity, actually was lower in 1972 than it was 50 years earlier, when it averaged 24.8 cents per gallon. Permitting prices of petroleum products to reflect their true costs would certainly not lead to windfall profits.

I would like also to comment upon Abelson's allusion to the "tremendous resources, both financial and technological" of the industry. This, of course, is true, but size does not necessarily imply success. The tasks facing the industry are tremendous as well, if our energy needs are to be met over the next decade. The domestic capital needs of the industry are estimated at about \$250 billion from 1971 through 1985—in 1970 dollars. According to one estimate, by 1985 we will need the equivalent of 160,000 productive oil and gas wells, some 400 to 500 large-capacity tankers, and the equivalent of

more than 50 new refineries, for example, just to keep pace with rising consumer demands for petroleum.

To this end, the American Petroleum Institute has recently issued a statement of policy on energy, outlining the goals we believe are necessary to ensure continuing supplies of energy. Among the points we consider important are four that Abelson mentions: a return of coal to its former markets, a national storage plan for oil, immediate funding of research into nonconventional sources of fuel, and a national program to encourage more efficient use of energy. This statement is available free of charge.

STEPHEN P. POTTER

*American Petroleum Institute,
1801 K Street, NW,
Washington, D.C. 20006*

Jason and the National Defense

The report on the defense consulting group Jason by Deborah Shapley (News and Comment, 2 Feb., p. 459) mentions the assertion by critics of the Kennedy Administration that those who aided the American war effort in Vietnam were guilty of "arrogance, amorality, or naiveté." It is a fact, however, that this is a democracy and that actions by the U.S. government are on behalf of a majority of the American people. It is not consistent to condemn those scientists who aid our national defense without condemning the majority of the U.S. population. In fact, the question could be raised as to the morality of those scientists who would attempt to thwart the will of the majority because of their peculiar position in the society. Is it right for a scientist to weaken the national defense by refusing to contribute his part to it, so long as this is a democracy?

Shapley states that "Jason originated during Project 137, a 1958 conference involving economist Oskar Morgenstern, and physicists Eugene P. Wigner and John Wheeler, who invited younger physicists along to familiarize themselves with military technical problems." Eugene Wigner had nothing to do with originating Jason. He has many times contributed his efforts to the national defense, but he has taken almost no part in the activities of Jason.

There are two compelling reasons why university scientists should act as consultants on national defense for the

U.S. government. (i) Such consulting introduces the thinking of university people into government planning. (ii) Without the contribution of American scientists to the development of new weapons, the United States would fall far behind predatory nations who would like to expand their borders and impose their will on others.

The News and Comment report pictures members of Jason as being continually apologetic for their contributions to national defense. I hope they are not, because their efforts are essential if the United States is to remain a government of free people.

ARTHUR A. BOYLES
Department of Physics and
Astronomy, University of
Florida, Gainesville 32601

The Jason group itself did not originate during Project 137. But some young physicists who participated in the project formalized their relations with the Department of Defense, as the Jason group, the following year.—D.S.

We applaud the attention that *Science* has given to the Jason Division of IDA (Institute for Defense Analysis). Having recently published our own extensive study on the subject (1), we would like to comment on the issues that are reported.

We do not believe that Jason scientists are any more immoral, amoral, arrogant, or naive than many other scientists in this country. They are distinguished only by having been given the opportunity to participate at the very highest levels of national policy-making; and their now-publicized contributions to the war in Vietnam have brought them into the spotlight. While Jason members' possible complicity in war crimes is a serious legal question, our major interest lies in seeing the broadest political implications in the whole Jason story.

One cannot view the Jason participants as simply neutral technical advisors. They work within a highly politicized context, defined by the objectives of the Department of Defense (DOD) and, more broadly, by the foreign policy of the Cold War. The Jason members, in accepting the secret and subservient nature of their advisory relationship to the DOD, have isolated themselves from any alternative political potential. Given this state of affairs, it would be foolish for Jason members to think that they as individ-

uals could exert a politically liberalizing influence through their inside connections. ("You don't confront generals," was how one Jason member described their relations with the Pentagon brass during a briefing on Vietnam.)

Thus, the only option for Jasons who personally opposed the war in Indochina was to offer alternative technical solutions to the failing military campaign, solutions which were then utilized by the government, in fact, to prolong the war. This is the history of the automated battlefield, conceived by Jason in 1966.

Jason serves to oversee and correlate scientific research in many areas and to select for future exploitation those developments which might prove valuable to long-range military interests (2). Thus, when many concerned scientists bemoan the fact that so much of "pure" research ends up being applied to objectionable ends, we should understand that this is no accident, but a direct result of careful design. Furthermore, beyond its purely technical functions, Jason serves as an important ideological model for science in this country, since the prestige of such groups serves to legitimize the whole spectrum of scientists' involvement with the military.

Our basic criticism of Jason is that it is intrinsically antidemocratic. It helps to put more power into the hands of a centralized and secretive military-political-economic apparatus which already has monopolized too much of the power in this country and throughout the world. It is not enough, at this time, for Jason members to express their personal regrets over their past contributions to the Vietnam war. The most constructive action they can take is to publicly resign from Jason, and from any similar organizations, and to make public the full scope of Jason-type activities.

CHARLES SCHWARTZ
MARTIN BROWN

*Scientists and Engineers for Social
and Political Action, Box 4161,
Berkeley, California 94704*

References and Notes

1. *Science Against the People* (Berkeley SESPA, Berkeley, Calif., 1972).
2. *The Report of the 1971 Jason Laser Summer Study* (IDA Study S-391, Arlington, Va., 1971) is an example of this. Their figures show that 80 percent or more of the federal funds for laser development are in military areas, but we cannot learn more about this because volume 3 ("Unique military applications of lasers") of the Jason report is classified.

The most accurate dilutor made.

Naturally, its also the most expensive.



What makes the Brinkmann Automatic Dilutor so expensive (\$2,700) is what makes it so phenomenally accurate: a digital electronic volume setting system, and two precision cylinder and piston assemblies (with only two moving parts in each).

Sample and reagent are mixed additively, automatically. Liquids contact only glass and PTFE components. Simple, push-button operation. Operating range: Reagent, 1.0 to 5,000 μ l in steps of 1.0 μ l; Sample, 0.1 to 500 μ l in steps of 0.1 μ l.

Before you splurge, get our literature. Just write: Brinkmann Instruments, Cantiague Rd., Westbury, N.Y. 11590. In Canada, write: Brinkmann Instruments (Canada) Ltd., 50 Galaxy Blvd., Rexdale (Toronto), Ont.

Brinkmann 

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

1973

H. S. GUTOWSKY	GARDNER LINDZEY
AUTHUR D. HASLER	RAYMOND H. THOMPSON
RUDOLF KOMPFFNER	EDWARD O. WILSON
DANIEL E. KOSHLAND, JR.	

1974

ALFRED BROWN	FRANK W. PUTNAM
JAMES F. CROW	MAXINE SINGER
SEYMOUR S. KETY	GORDON WOLMAN
FRANK PRESS	

Editorial Staff

Editor

PHILIP H. ABELSON

<i>Publisher</i>	<i>Business Manager</i>
WILLIAM BEVAN	HANS NUSSBAUM

Managing Editor: ROBERT V. ORMES

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

Assistant to the Editor: NANCY TEIMOURIAN

News and Comment: JOHN WALSH, LUTHER J. CARTER, DEBORAH SHAPLEY, ROBERT GILLETTE, NICHOLAS WADE, CONSTANCE HOLDEN, BARBARA J. CULLITON, SCHERRAINE MACK

Research News: ALLEN L. HAMMOND, WILLIAM D. METZ, THOMAS H. MAUGH II, JEAN L. MARX

Book Reviews: SYLVIA EBERHART, KATHERINE LIVINGSTON, ANN SELTZ-PETRASH

Cover Editor: GRAYCE FINGER

Editorial Assistants: MARGARET ALLEN, ISABELLA BOULDIN, BLAIR BURNS, ELEANORE BUTZ, MARY DORFMAN, JUDITH GIVELBER, CORRINE HARRIS, NANCY HARTNAGEL, OLIVER HEATWOLE, CHRISTINE KARLIK, MARSHALL KATHAN, MARGARET LLOYD, JEAN ROCKWOOD, PATRICIA ROWE, LEAH RYAN, JOHN SCHAUER, LOIS SCHMITT, MICHAEL SCHWARTZ, YA LI SWIGART

Guide to Scientific Instruments: RICHARD SOMMER

Membership Recruitment: LEONARD WRAY; *Subscription Records and Member Records:* THOMAS BAZAN

Advertising Staff

<i>Director</i>	<i>Production Manager</i>
EARL J. SCHERAGO	PATTY WELLS

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: John P. Cahill, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); Beverly Hills, Calif. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772)

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: 467-4440. Cable: Advancesci, Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. See also page xv, *Science*, 30 March 1973. ADVERTISING CORRESPONDENCE: Room 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE-6-1858.

Spain—Another Japan?

On 11 to 14 April, an international symposium in Madrid brought together some of the Western world's formulators and students of policy for science and technology. The meeting was particularly well timed, for it came at a moment of change when well-established policies were being questioned amid universal awareness of the role of technology in improving standards of living. Moreover, with a nuclear stalemate, commercial competition has become the principal arena for rivalry and the guest for prestige among nations.

For many years the United States was the world's unchallenged leader in science, and our mass production methods provided a great advantage in commercial competition. But other nations, particularly Japan, have adopted and even improved on our production methods, and such advantage as remains lies largely in high technology based on new science. Still, the aura of leadership remained, and others tended to follow us in policies for science and technology. The sudden abolishment of the President's science advisory apparatus and another devaluation of the dollar have raised questions about our status as leaders.

Impressed by our prowess in matters involving high technology, most of the advanced countries had attempted to adapt our policies to their use. These policies included emphasis on basic research at universities and large total expenditures for research and development (up to 3 percent of the gross national product). But now that our role as leader is coming under question, there is a tendency to look toward other models. An obvious alternative is Japan.

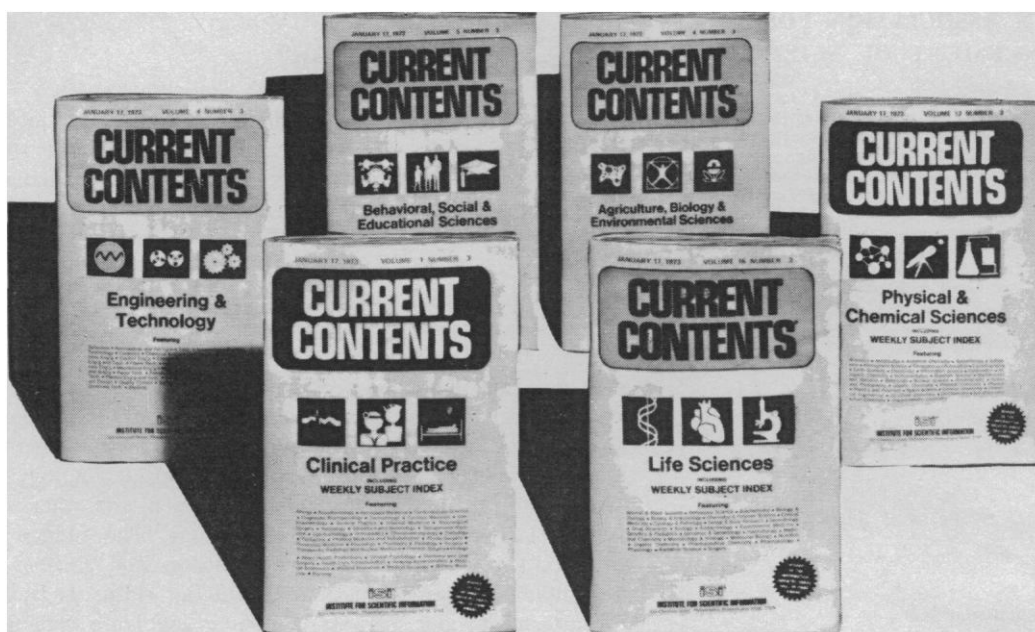
In its postwar development, Japan followed a different course from that of other advanced countries. While it supported some research at universities, it did not depend on technologies arising out of its own scientific efforts. Rather, Japan invested in foreign know-how, and then improved on it. This had the advantage that the Japanese did not pay for research that failed or for processes producing products that did not sell. In addition, they saved the many years required for R & D. Japan's example is now being followed by Spain, and Spain, in turn, may well serve as a model for other developing countries.

Spain, which is in the midst of a great industrial and construction boom and which is being hailed as "another Japan," has departed even further from U.S. policies. There is practically no research at the universities and little in industry. Government support of R & D is at the level of about 0.2 percent of the gross national product. Industrialization is heavily dependent on foreign know-how. Direct payments for royalties, patents, and the like last year amounted to \$170 million. However, indirect payments (for example, participation in ownership ventures) may bring the total payments to \$500 million (more than seven times governmental expenditures for R & D). This is a huge sum for a country only modestly endowed, but at present the proceeds from tourism (more than \$2 billion) far exceed it.

It is difficult to argue against success, but are the present policies of Spain viable for the long term, and are they useful models for other developing countries? Probably not. Other developing countries cannot hope to earn huge sums from tourism. Spain's failure to nurture a scientific establishment consigns it to a long-term dependency on foreign expertise, to being a follower rather than a leader.

The Spanish are a proud people, and the scientists among them are now deeply frustrated. They know that, given a fair chance, they could compete well and contribute internationally, while serving their country. It is sad to see a nation that neglects its greatest natural resource—its brains.—PHILIP H. ABELSON

the most widely used
scientific information system in the world



Try any edition free for 4 weeks.

Nearly 200,000 professionals of all types use the *Current Contents*® system every week to locate and obtain new journal articles relevant to their work. And they've got good reasons.

Current Contents is the most comprehensive, least complicated way to make sure you learn of new developments in your field while they're still new. Just an hour a week spent scanning any edition of *Current Contents* lets you sort through everything that's published in a thousand or more journals. With CC® it's easy to pick out just those articles you want to read. Without handling the journals. Without increasing your journal subscription expenses.

Find out why so many people like you use *Current Contents*. Get more information and a free 4-week subscription by completing the coupon.

©1973 ISI

Please start my free 4-week subscription to the *Current Contents*® edition checked below:

- ☐ Life Sciences
- ☐ Physical & Chemical Sciences
- ☐ Agriculture, Biology & Environmental Sciences
- ☐ Behavioral, Social & Educational Sciences
- ☐ Engineering & Technology
- ☐ Clinical Practice

Name _____
Title _____
Organization _____
Street Address _____
City _____ State/Province _____
Zip _____ Country _____

ISI®

Institute for Scientific Information

325 Chestnut St., Philadelphia, Pa., U.S.A. 19106 Tel.: (215) 923-3300, Cable: SCINFO, TELEX: 84-5305

29-351