4 April 1980 • Vol. 208 • No. 4439 $1.50

# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

# AAAS BOOKS AAAS BOOKS

From heart disease to solar energy, from food to electronics—the American Association for the Advancement of Science publishes books which cover these topics and many more. Books that will keep you informed and abreast of important scientific advancements. Books that are designed for the researcher, scientist, engineer, student, and general public. Books that you need to read.

## AAAS SCIENCE REPORT SERIES

*Combating the #1 Killer: The SCIENCE Report on Heart Research, by Jean L. Marx and Gina Bari Kolata.* Based on the American Heart Association's Blakeslee Award-winning articles in SCIENCE, this book presents an overview of the status of current research on all aspects of cardiovascular diseases. xi + 205 pp. $17.00 (case); $7.50 (paper).

*Solar Energy in America, by William D. Metz and Allen L. Hammond.* Chapters deal with research strategies of both government and industry: "Power Towers," photovoltaic cells and other collector strategies, fuel photosynthesis, wind and ocean thermal power, energy storage, and more. Fall 1978. $18.00 (case); $8.50 (paper).

Two other AAAS series, Compendia and R&D Reports, provide authoritative information on some of the principal issues that concern us all today. These publications can serve not only as valuable reference sources for scientists and researchers, but also as supplementary reading material in courses devoted to these issues.

## AAAS SCIENCE COMPENDIA SERIES

*ENERGY: Use, Conservation and Supply; Volume II.* vi + 202 pp. $14.00 (case); $6.00 (paper).

*ELECTRONICS: The Continuing Revolution.* iv + 217 pp. $12.00 (case); $4.50 (paper).

*MATERIALS: Renewable and Nonrenewable Resources.* x + 198 pp. $12.00 (case); $4.50 (paper).

*POPULATION: Dynamics, Ethics and Policy.* viii + 184 pp. $12.00 (case); $4.50 (paper).

*FOOD: Politics, Economics, Nutrition and Research.* vi + 202 pp. $12.00 (case); $4.50 (paper).

*ENERGY: Use, Conservation and Supply; Volume I.* vi + 154 pp. $10.00 (case); $3.50 (paper).

*HEALTH CARE: Regulation, Economics, Ethics, Practice.* iv + 256 pp. Fall 1978. $14.00 (case); $6.00 (paper).

## AAAS RESEARCH & DEVELOPMENT REPORT SERIES

***Research & Development: AAAS Report IV.*** **xvi + 137 pp. $6.50** (paper).

*Research & Development in the Federal Budget: FY 1978.* xii + 148 pp. $5.00 (paper).

*Research & Development: AAAS Report III.* xiv + 122 pp. $5.00 (paper).

*Research & Development in the Federal Budget: FY 1977.* ix + 100 pp. $5.00 (paper).

Now . . . it's your turn to let us know how we can help you. . . .

To order your individual copies of the above titles, please send your name, address, and list of book titles (indicate case or paper) to AAAS, Department JB-1, 1515 Massachusetts Avenue, NW, Washington, DC 20005. Remittance must accompany all orders under $10.00. Please allow 6-8 weeks for delivery.

# VOICES


Our radiochemical catalogs and data sheets are informative. But a conversation can be much more enlightening. Sometimes talking to one of our technical staff can answer your question more handily than a literature search. Our staff is available to you without hesitation, because we know it's good business to share our 23 years of experience in tracer methodology.

This is not to underrate the first voice you hear when you call with an order. Our customer service people know the products, their schedules, method of shipment, delivery time, and—most important—the service needs of their individual accounts. They may well know your voice, your special requirements, and your license number, because we have assigned each person to a sales region.

And all of the above is toll-free on 800-225-1572.

NEN® New England Nuclear

Label of Excellence

ISSN 0036-8075

4 April 1980

Volume 208, No. 4439

# SCIENCE





**CIENCE 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. 0005.** Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly®**.  Domestic individual membership and subscription (51 issues): $38. Domestic institutional subscription (51 issues): $76. Foreign postage extra: Canada $14, other (surface mail) 7, air-surface via Amsterdam $45. 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 ldress:** 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 dexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

# AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





**COVER**

Fireflies glowing after exposure to the formamidine pesticide, chlordimeform. Of the ten insects, nine were treated with 1 microgram each of chlordimeform. The tenth firefly, which is unlit, was treated only with the acetone solvent. See page 74. [Jeffrey A. Leister, Department of Entomology, Purdue University, West Lafayette, Indiana]

4 April 1980, Volume 208, Number 4439 **SCIENCE**



# Zero—What Does It Mean?

Pollution of the environment, additives in food, exposure to radiation, hazards in the workplace, and identification of carcinogens are resulting in calls for zero discharge of pollutants, zero contamination, zero radiation, and zero risk. Congress, state and local governments, and their respective administrative agencies have responded with a stream of new laws and regulations. Some citizens' organizations and legislators are seeking the elimination of all pollution or of what are considered contaminants.

This desire to obtain zero is causing consternation in the minds of many engineers and scientists. When people speak of zero they apparently mean different things. And even in the case of scientific analysis, zero has changed. A few years ago analytical methods might have indicated the absence of a particular chemical in a test sample. Today, with better analytical methods, that same sample would show the particular chemical present; we no longer have the zero we had a few years ago.

Analytical methods are now measuring such minute quantities of chemicals (parts per billion and even parts per trillion) that supposedly identical samples of water from the same effluent, when analyzed, show different concentrations of pollutants. The problem may be one of humans not being skilled enough to get reproducible results with sophisticated equipment (assuming the equipment is not at fault), or it may be like the four blind men trying to identify the elephant—by touching different parts of the elephant, they come up with different conclusions about what an elephant is.

Concern about radioactivity's effect on health is resulting in calls for zero radiation, particularly where nuclear power plants are concerned. And yet there is naturally occurring radiation from space, from rocks, and even from our own bodies and food. Such radioactivity varies from place to place by as much as 400 to 500 percent. Knowing, then, that nowhere on earth is there zero radiation, are we talking about zero based on a particular location—and if so, which location? Or are we talking about a permissible level that is believed to be safe for human beings?

With the advent of new machines, new materials and chemicals, and new modes of living and with a greater knowledge of the things around us, we have suddenly become aware of new risks or risks we were not previously aware of. Through the years society has become used to and accepted certain risks. People learned to control fire, to build homes away from flooding rivers and volcanoes, to control the internal combustion engine. All of these things involve risks. Society has been able to reduce risks in many instances, but where natural forces are involved, risks are always present.

What do we mean when we ask for zero risk? Does zero mean a standard, a limit, or perhaps a goal for each kind of risk? Will we accept (and call zero) 50,000 deaths a year from automobiles, 100 deaths from airline traffic, or 25 to 60 deaths attributable to producing electricity from coal, but refuse to accept any deaths from nuclear power plants producing electricity because we don't want to risk a possible unknown?

Webster's dictionary defines zero (other than the numeral) as (i) a state of total absence or neutrality; (ii) the lowest point, nadir; and (iii) something arbitrarily or conveniently designated zero. In calling for zero, people may be asking for a state of total absence. However, just as it is impossible to stop killer hurricanes and to keep people from falling out of bed, we know we are going to have accidents if we use fire to heat our homes and cook our meals or use other new things that improve the quality of life and lengthen our life-span.

Knowing this, we may have to accept "something arbitrarily or conveniently designated zero" for pollutants, radiation, and risk. The costs of guessing at zero are enormous; laws and regulations must come to grips with this problem. Until they do, costs to society can only continue to go up. Everyone's checkbook will feel it—and there we all know what zero means.—MITCHELL H. BRADLEY, *Washington Office Director, American Society of Mechanical Engineers, Washington, D.C. 20006*

# THE ENERGY SERIES

## The Growing Energy Library from AAAS

**Solar Energy in America,** based on in-depth reporting for SCIENCE magazine, is a thorough assessment of our progress in tapping the ultimate energy source — the sun. While no single energy source may meet all future demands, solar energy seems to have the greatest potential. It is technically feasible, environmentally attractive, and rapidly becoming commercially sound. **Solar Energy in America** details the diverse technologies that depend upon the sun as their energy source, evaluates the potential and the problems of each, and alerts the reader to both the short-term and long-range prospects. The authors find that the field of solar energy is undergoing an unparalleled technical revival, and that there is no reason why many solar technologists cannot begin to be used at once. **Solar Energy in America** is a useful publication for solar energy enthusiasts as well as skeptics, for college students as well as policy analysts. It is a AAAS book for everyone who wants a broad and thorough perspective on solar energy today.

**Solar Energy in America;** by William D. Metz and Allen L. Hammond. 1978, xvi + 218 pages, index. Retail price: $18.50* (casebound), $8.50* (paperbound).

**ENERGY: Use, Conservation and Supply** (Volumes I & II) contain authoritative articles by the leading energy experts. Both books deal with the principal energy-related issues that face science and society today. **ENERGY–I** gives the reader a historical and general overview of our energy problems and examines ways to conserve energy and use it more efficiently. **ENERGY–II** focuses on our remaining supply of fossil fuels and the transition to fission, fusion and solar energy. It also provides an extensive analysis of present domestic and international energy-use patterns. **ENERGY–I** and **ENERGY–II** can serve as valuable reference sources for scientists and researchers, as well as supplementary reading in courses devoted to energy-related topics.

**ENERGY: Use, Conservation and Supply, Volume II;** edited by Philip H. Abelson and Allen L. Hammond. 1978, vi + 202 pages, index. Retail price $14.00* (casebound), $6.00* (paperbound).

**ENERGY: Use, Conservation and Supply, Volume I;** edited and with a foreword by Philip H. Abelson. 1974, vi + 154 pages, index. Retail price $10.00* (casebound), $3.50* (paperbound).

Special Combination Price for both **ENERGY** Volumes: $22.00* (casebound), $8.00* (paperbound).

**The Proceedings of the Conference on National Energy Policy** (a May 1977 conference sponsored by the AAAS, the Carnegie Institution of Washington, and The MITRE Corporation) is addressed to leaders in government, industry and academia whose responsibility it is to build, implement and understand the National Energy Plan.

**The Proceedings of the Conference on National Energy Policy;** 1977, xvi + 135 pages. Retail price $6.00* (paperbound only).

To order your copies of the above titles, please send your name, address, and list of book titles (indicate casebound or paper) to AAAS, Department CE, 1515 Massachusetts Avenue, NW, Washington, DC 20005. Remittance must accompany all orders under $10.00.

*AAAS members deduct 10% from retail price. Please allow 6–8 weeks for delivery.

aaas

American Association for the Advancement of Science