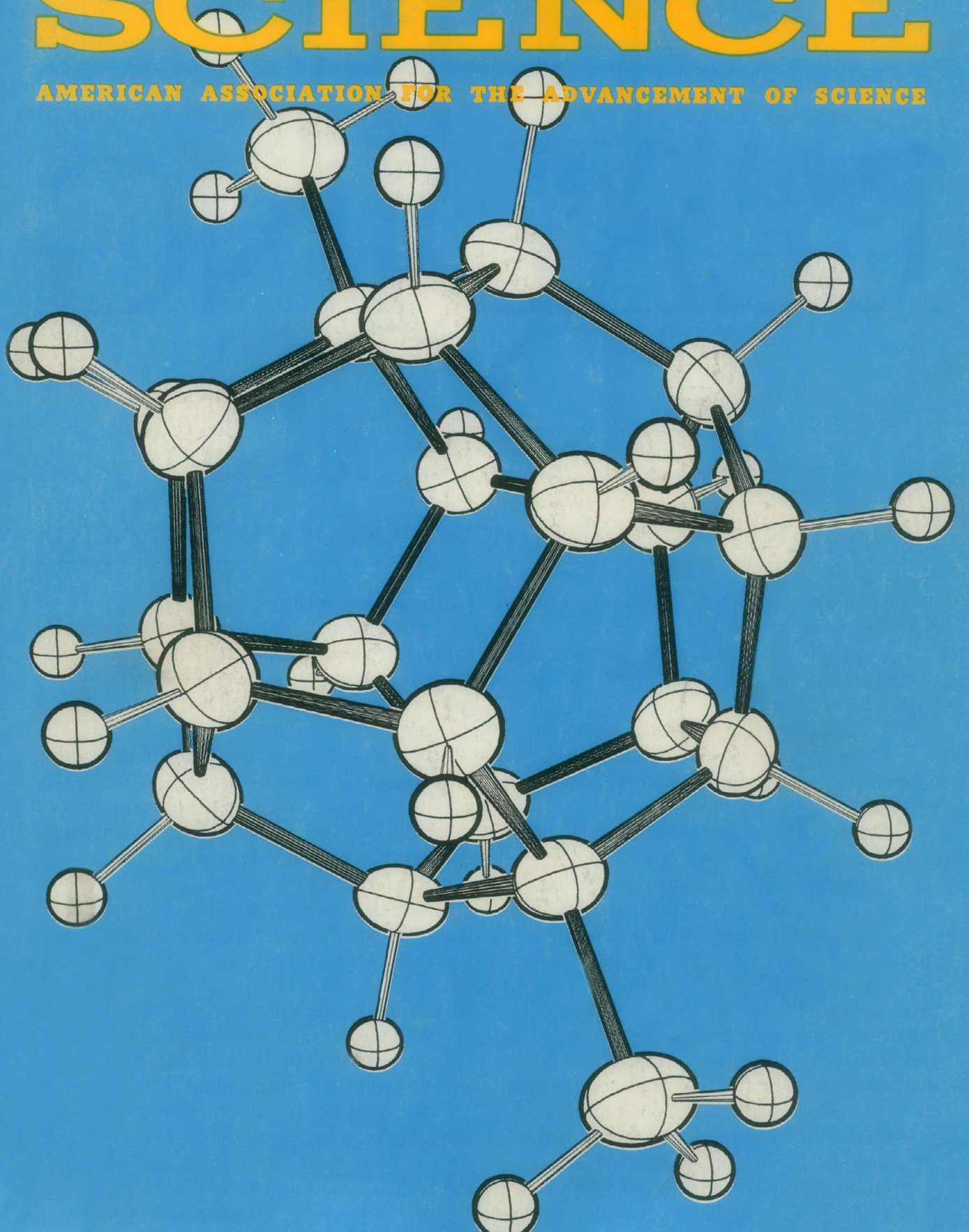
6 February 1981 • Vol. 211 • No. 4482 $2.00

# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



# THE LEADING EDGE

## #1 in a series of reports on new technology from Xerox

*About a year ago, Xerox introduced the Ethernet network—a pioneering new development that makes it possible to link different office machines into a single network that's reliable, flexible and easily expandable.*

*The following are some notes explaining the technological underpinnings of this development. They are contributed by Xerox research scientist David Boggs.*

The Ethernet system was designed to meet several rather ambitious objectives.

First, it had to allow many users within a given organization to access the same data. Next, it had to allow the organization the economies that come from resource sharing; that is, if several people could share the same information processing equipment, it would cut down on the amount and expense of hardware needed. In addition, the resulting network had to be flexible; users had to be able to change components easily so the network could grow smoothly as new capability was needed. Finally, it had to have maximum reliability—a system based on the notion of shared information would look pretty silly if users couldn't get at the information because the network was broken.

**Collision Detection**

The Ethernet network uses a coaxial cable to connect various pieces of information equipment. Information travels over the cable in packets which are sent from one machine to another.

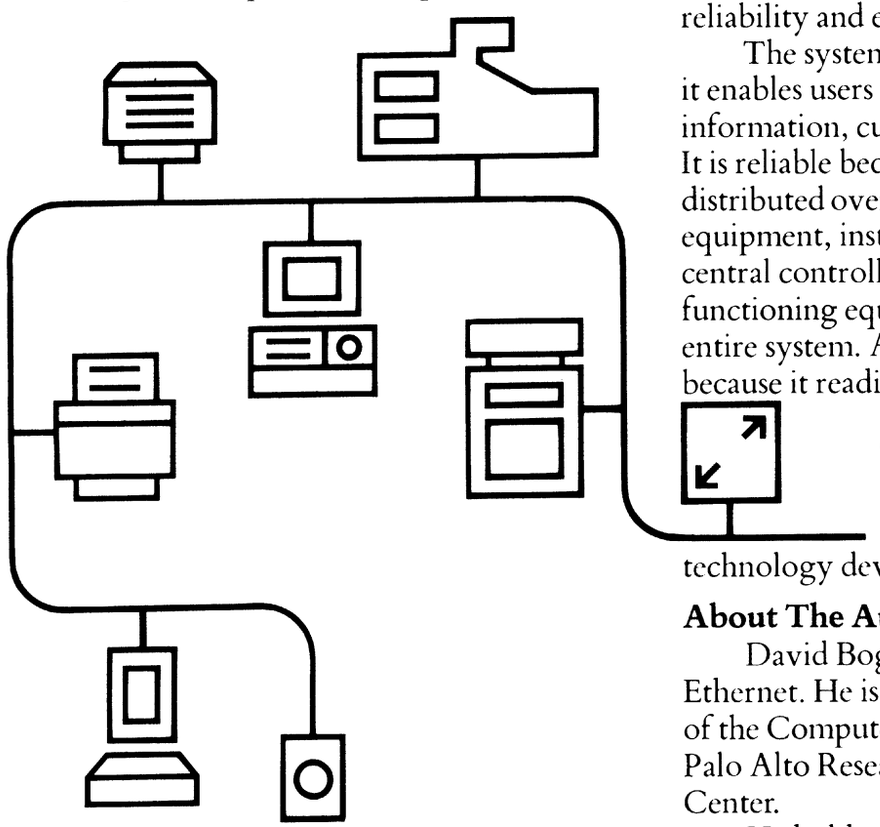
A key problem in any system of this type is how to control access to the cable: what are the rules determining when a piece of equipment can talk? Ethernet's method resembles the unwritten rules used by people at a party to decide who gets to tell the next story.

While someone is speaking, everyone else waits. When the current speaker stops, those who want to say something pause, and then launch into their speeches. If they *collide* with each other (hear someone else talking, too), they all stop and wait to start up again. Eventually one pauses the shortest time and starts talking so soon that everyone else hears him and waits.

When a piece of equipment wants to use the Ethernet cable, it listens first to hear if any other station is talking. When it hears silence on the cable, the station starts talking, but it also listens. If it hears other stations sending too, it stops, as do the other stations. Then it waits a

random amount of time, on the order of microseconds, and tries again. The more times a station collides, the longer, on the average, it waits before trying again.

In the technical literature, this technique is called carrier-sense multiple-access with collision detection. It is a modification of a method developed by researchers at the University of Hawaii and further refined by my colleague Dr. Robert Metcalfe. As long as the interval during which stations elbow each other for control of the cable is short relative to the interval during which the winner uses the cable, it is very efficient. Just as important, it requires no central



control—there is no distinguished station to break or become overloaded.

## The System

With the foregoing problems solved, Ethernet was ready for introduction. It consists of a few relatively simple components:

Ether. This is the cable referred to earlier. Since it consists of just copper and plastic, its reliability is high and its cost is low.

Transceivers. These are small boxes that insert and extract bits of information as they pass by on the cable.

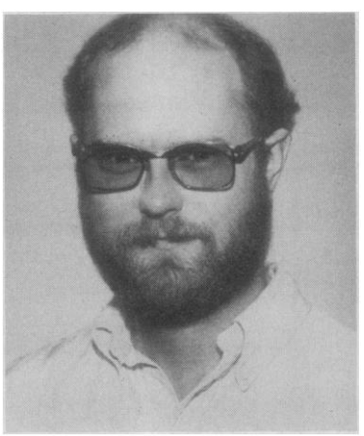
Controllers. These are large scale integrated circuit chips which enable all sorts of equipment, from communicating typewriters to mainframe computers, regardless of the manufacturer, to connect to the Ethernet.

The resulting system is not only fast (transmitting millions of bits of information per second), it's essentially modular in design. It's largely because of this modularity that Ethernet succeeds in meeting its objectives of economy, reliability and expandability.

The system is economical simply because it enables users to share both equipment and information, cutting down on hardware costs. It is reliable because control of the system is distributed over many pieces of communicating equipment, instead of being vested in a single central controller where a single piece of malfunctioning equipment can immobilize an entire system. And Ethernet is expandable because it readily accepts new pieces of information processing equipment. This enables an organization to plug in new machines gradually, as its needs dictate, or as technology develops new and better ones.

## About The Author

David Boggs is one of the inventors of Ethernet. He is a member of the research staff of the Computer Science Laboratory at Xerox's Palo Alto Research Center.



He holds a Bachelor's degree in Electrical Engineering from Princeton University and a Master's degree from Stanford University, where he is currently pursuing a Ph.D.

XEROX

ISSN 0036-8075

6 February 1981

Volume 211, No. 4482

# SCIENCE

**LETTERS** Science and Engineering: The Future: *S. Ramo*; High-Energy Physics: Magnet Technology: *S. D. Drell*; Toward Equality: *S. M. Stigler* and *V. L. Stigler* . . . . . 532

**EDITORIAL** East Is East and West Is West. . . . . 533

**ARTICLES** Three-Dimensional Methods in Seismic Exploration: *R. Graebner, C. Wason, H. Meinardus* . . . . . 535

Organic Farming in the Corn Belt: *W. Lockeretz, G. Shearer, D. H. Kohl* . . . . . 540

Rural Africa: Modernization, Equity, and Long-Term Development: *U. Lele* . . . . 547

**NEWS AND COMMENT** Weinberger Promises Leaner, Meaner DOD . . . . . 554

Former Carolina Governor to Head DOE . . . . . 555

Beryllium Report Disputed by Listed Author . . . . . 556

FAA Is Cool to Cabin Safety Improvements . . . . . 557

*Briefing*: Fredrickson Asked to Be a Holdover Again at NIH; Senate Westerners Stake a Claim; White House Science Still in Transition; Brown Departs Research Subcommittee . . . . . 558

Medical Journal Draws Lancet on Rival . . . . . 561

**RESEARCH NEWS** !Kung Bushmen Join South African Army . . . . . 562

Lake Bottoms Linked with Human Origins . . . . . 564

**AAAS NEWS** 1980 AAAS Awards Presented in Toronto; Washington Meeting in 1982; Pacific Division Announces Meeting; Energy Seminars in 1981; OOS Completes Inventory of Programs for Women; Global Seminar Held in New Delhi: *D. Weiner*; 50-Year Members Acknowledged; AAAS and ISETAP . . . . . 567



**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®**.  Domestic individual membership and subscription (51 issues): $38. Domestic institutional subscription (51 issues): $76. Foreign postage extra: Canada $14, other (surface mail) $17, air-surface via Amsterdam $45. First class, airmail, school-year, and student rates on request. Single copies $2 ($2.50 by mail); back issues $3 ($3.50 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


**BOOK REVIEWS** Cretaceous/Tertiary Boundary Events, *reviewed by T. J. M. Schopf*; The Puuc, *M. D. Coe*; Baboon Mothers and Infants, *R. W. Wrangham*; Membrane Transport in Erythrocytes, *D. Levitt*; Senescence in Plants, *H. Kende* . . . . . 571

**REPORTS** Crystal and Molecular Structure of a Pentagonal Dodecahedrane: *L. A. Paquette* et al. . . . . 575

Petroleum Drilling and Production in the United States: Yield per Effort and Net Energy Analysis: *C. A. S. Hall* and *C. J. Cleveland* . . . . . 576

Submillimeter Heterodyne Detection of Interstellar Carbon Monoxide at 434 Micrometers: *H. R. Fetterman* et al. . . . . 580

Virus in a Parasitoid Wasp: Suppression of the Cellular Immune Response in the Parasitoid's Host: *K. M. Edson* et al. . . . . 582

Type III Hyperlipoproteinemia: Defective Metabolism of an Abnormal Apolipoprotein E: *R. E. Gregg* et al. . . . . 584

Specific and Sensitive Radioimmunoassay for 3-Methoxy-4-hydroxyphenylethyleneglycol (MOPEG): *T. K. Keeton, H. Krutzsch, W. Lovenberg* . . . . . 586

Two Classes of Single-Stranded Regions in DNA from Sea Urchin Embryos: *M. S. Wortzman* and *R. F. Baker* . . . . . 588

Regulation of Cutaneous Previtamin $D_3$ Photosynthesis in Man: Skin Pigment Is Not an Essential Regulator: *M. F. Holick, J. A. MacLaughlin, S. H. Doppelt* . . 590

2,4,5-Trichlorophenoxyacetic Acid Causes Behavioral Effects in Chickens at Environmentally Relevant Doses: *C. A. Sanderson* and *L. J. Rogers* . . . . . 593

Neurosecretory Granules: Evidence for an Aging Process Within the Neurohypophysis: *J. J. Nordmann* and *J. Labouesse* . . . . . 595

Lectins of Distinct Specificity in *Rhodnius prolixus* Interact Selectively with *Trypanosoma cruzi*: *M. E. A. Pereira, A. F. B. Andrade, J. M. C. Ribeiro* . . . 597

Oxidation of Elemental Selenium to Selenite by *Bacillus megaterium*: *S. U. Sarathchandra* and *J. H. Watkinson* . . . . . 600

Effects of Vasopressin on Human Memory Functions: *H. Weingartner* et al. . . . . 601

Metkephamid, a Systemically Active Analog of Methionine Enkephalin with Potent Opioid δ-Receptor Activity: *R. C. A. Frederickson* et al. . . . . 603

Endogenous Late Positive Component of the Evoked Potential in Cats Corresponding to P300 in Humans: *M. B. Wilder, G. R. Farley, A. Starr* . . . . 605

Lunar Phasing of the Thyroxine Surge Preparatory to Seaward Migration of Salmonid Fish: *E. G. Grau* et al. . . . . 607




**COVER**

Three-dimensional view of 1,16-dimethyldodecahedrane as determined by x-ray analysis. See page 575. [Bob Hummel, Biomedical Communications, Ohio State University, Columbus]

# MINC lets you spend less time gathering data and more time using it.

Set up a MINC computer in your lab. Connect your instruments. Run your experiments. Suddenly, you'll notice you've got extra time. Time you never had before.

Time to manage. Time to interpret. Time to conceptualize, theorize, extrapolate. Time to make good use of all that data you once spent so much time collecting.

That's the value of MINC: the Digital family of convenient, inexpensive laboratory computer systems.

MINC is designed specifically for scientific use. It interfaces easily with lab equipment. It has the versatility to perform a wide variety of research tasks. And it comes with graphics display, plug-in input/output modules, and easy-to-use, ready-to-run software routines. So even if you've never used a computer before, you can have MINC fully integrated into your lab with a minimum of training and start-up time.

Of course, with MINC, you get a lot more than just time. You get the service, resources, and reputation of Digital, the undisputed leader in laboratory computers. Now MINC is available with the powerful Digital PDP-11/23 microcomputer. Which means it's more than just reliable. It's compatible with most other Digital computers. As your lab grows, this extensive compatibility assures you that your investment in Digital equipment is always protected.

There are now three MINC computer systems to choose from, priced from $9,900 to $30,900.* A Digital Laboratory Data Products representative can tell you all about them. You'll see just how easy it is to bring a MINC into your lab. And just how valuable a tool it can be.

MINC. For the work it does. And for the time it spares you.

TO: Digital Equipment Corporation
Laboratory Data Products Group MR 2-4/M 16
One Iron Way, Marlboro, Mass. 01752
(617) 467-5869

European headquarters: 12 av. des Morgines, 1213 Petit-Lancy/Geneva.
In Canada: Digital Equipment of Canada, Ltd.

Yes, maybe we can be using our time more effectively. Tell me more about MINC.

Name_____

Title_____

Organization_____

Address_____

City_____

State_____ Zip_____ Phone_____

SCI 2/6/80 D-X397

*Prices apply in U.S.A. only. MINC (Modular INstrument Computer) is a trademark of Digital Equipment Corporation.

digital

6 February 1981, Volume 211, Number 4482 **SCIENCE**



# East Is East and West Is West

In attitudes toward other countries, Americans are often remarkably parochial. We assume that others share or at least ought to share our beliefs and values. We would do well to remember the words of Rudyard Kipling, "East is East, and West is West, and never the twain shall meet."

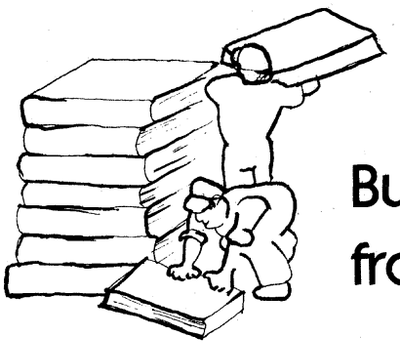
A typical tourist visiting Japan could easily conclude that the country has gone far toward becoming like the United States. The procedures at Nerita are much like those at any major international airport. In the streets of Tokyo there is the familiar sight of rushing automobiles. Modern hotels are very similar to those in the United States. Indeed, in Kyoto, the old imperial capital, one can stay in a Holiday Inn and partake of McDonald's hamburgers. A golf driving range there is open until late hours. Perhaps the most obvious indication of Americanization is the Coca Cola signs, which are ubiquitous.

But stray away from the Western hotel and you will get some different impressions. One aspect of Japanese life in which there has been little change is the role of women. During visits to industrial laboratories, government institutions, and ministries and attendance at scientific sessions I met several hundred professional people. Women were present in offices in clerical positions. They appeared bearing cups of tea. They were present, but segregated, in one phase of a color television assembly line. But I encountered only two women in professional roles. I was informed that recently, due to a severe shortage of men, some women had been hired to do computer programming. On a number of occasions I was in mixed company when it was necessary to enter a room or an elevator. When I attempted to permit the women present to enter first, awkwardness resulted.

In dealing with each other, animals of many species, including humans, are more or less conscious of pecking order. In the United States there are a few areas, such as diplomacy and the military, in which people are acutely aware of it. But in general we practice the dictum that all men are created equal, and a person who seems too anxious about his or her relative standing is not well regarded.

In Japan the situation is quite different. Status is extremely important, and striving to achieve it begins almost at the cradle. Acute awareness of and behavior according to pecking order persist throughout life. This is reinforced by the structure of the language. Conjugation of verbs and forms of personal pronouns are dependent on the relative status of the people involved in a conversation. There are as many as 93 forms (some archaic) of the personal pronouns "I" and "me." With social structure embedded in the language, it is hardly likely that changes will occur quickly.

Interestingly, rigidity in the pecking order is accompanied by an unusual cohesiveness of the people and a practice of consulting persons high or low who would be affected by a decision. There is a very strong tendency to conciliate rather than litigate. One measure of this is that in Japan there are fewer than 12,000 lawyers, while in the United States there are about 500,000. In the United States, the relatively large number of lawyers seems to encourage conflict and friction rather than to resolve it amicably. A Japanese lawyer told me that in Japan a typical contract between two parties might involve a paragraph or two, but that in the United States a comparable matter might involve 200 pages in an attempt to foresee all possible contingencies. He said that in Japan, if contingencies arise, the parties share some sake and work out an equitable agreement. In environmental matters, where the Japanese have made more progress than we have, again there has been conciliation instead of prolonged litigation. For centuries, the Japanese have lived in crowded, isolated circumstances, and the present culture was shaped by those conditions. We may not like or approve of all their customs, but they seem to suit the Japanese well.—PHILIP H. ABELSON



# Build Your Library with Books from Science Magazine

**Solar Energy in America**
by William D. Metz and Allen L. Hammond
Evaluates research strategies in the development of solar energy, covering the power tower concept; photovoltaic cells and other collectors; and biomass, wind, ocean thermal, and other energy sources. Includes illustrations, a directory of solar energy companies and wind turbine generator manufacturers, and a federal budget summary for solar energy research, FY 1979.
256 pp. 1978 Illus.
ISBN: 0-87168-238-9 (paper) $8.50

**Combating the #1 Killer: The Science Report on Heart Research**
by Jean L. Marx and Gina Bari Kolata
Presents readable, in-depth looks at the epidemiology of heart disease, its diagnosis and relationship to lifestyle, the most promising current and projected treatments, research in progress, and ethical problems which may confound research results. The authors won the American Heart Association's Blakeslee Award for the Science articles on which this book is based. 224 pp. 1978 Illus.
ISBN: 0-87168-235-4 (paper) $7.50

## Science Compendia Series

**Advanced Technology**
Edited by Philip H. Abelson and Mary Dorfman
168 pp. 1980 Illus.
ISBN: 0-98168-303-2 (cloth) $14.00
ISBN: 0-87168-249-0 (paper) $ 6.00

**Electronics: The Continuing Revolution**
Edited by Philip H. Abelson and Allen L. Hammond
224 pp. 1977 Illus.
ISBN: 0-87168-217-6 (cloth) $10.00
ISBN: 0-87168-230-3 (paper) $3.50

***Energy: Use, Conservation and Supply (Vol. 1)**
Edited by Philip H. Abelson
160 pp. 1974 Illus.
ISBN: 0-87168-213-3 (cloth) $10.00
ISBN: 0-87168-237-0 (paper) $3.50

***Energy: Use, Conservation, and Supply (Vol. 2)**
Edited by Philip H. Abelson and Allen L. Hammond
208 pp. 1978 Illus.
ISBN: 0-87168-300-8 (cloth) $12.00
ISBN: 0-87168-237-0 (paper) $5.00

**Food: Politics, Economics, Nutrition, and Research**
Edited by Philip H. Abelson
208 pp. 1975 Illus.
ISBN: 0-87168-215-X (cloth) $10.00
ISBN: 0-87168-226-5 (paper) $3.50

**Health Care: Regulation, Economics, Ethics, Practice**
Edited by Philip H. Abelson
262 pp. 1978 Illus.
ISBN: 0-87168-302-4 (cloth) $12.00
ISBN: 0-87168-240-0 (paper) $5.00

**Materials: Renewable and Nonrenewable Resources**
Edited by Philip H. Abelson and Allen L. Hammond
208 pp. 1978 Illus.
ISBN: 0-87168-216-8 (cloth) $10.00
ISBN: 0-87168-225-3 (paper) $3.50

**Population: Dynamics, Ethics, and Policy**
Edited by Priscilla Reining and Irene Tinker
208 pp. 1975 Illus.
ISBN: 0-87168-214-1 (cloth) $10.00
ISBN: 0-87168-225-7 (paper) $3.50

*Special two-volume price: hardbound $20.00, paperbound $7.00

---

Build my library, AAAS! Send me the following books:

| # of Copies | Title | Price | Total |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

– 10% discount** _____

TOTAL _____

☐ Bill me (all orders under $10.00 must be prepaid)

☐ Payment enclosed (10% discount to AAAS members on prepaid orders)**

Name _____

Address _____

City _____ State _____ Zip _____

Please allow 6-8 weeks for delivery.

Order from: AAAS, Dept. J-1-80, 1515 Massachusetts Ave., NW, Washington, DC 20005