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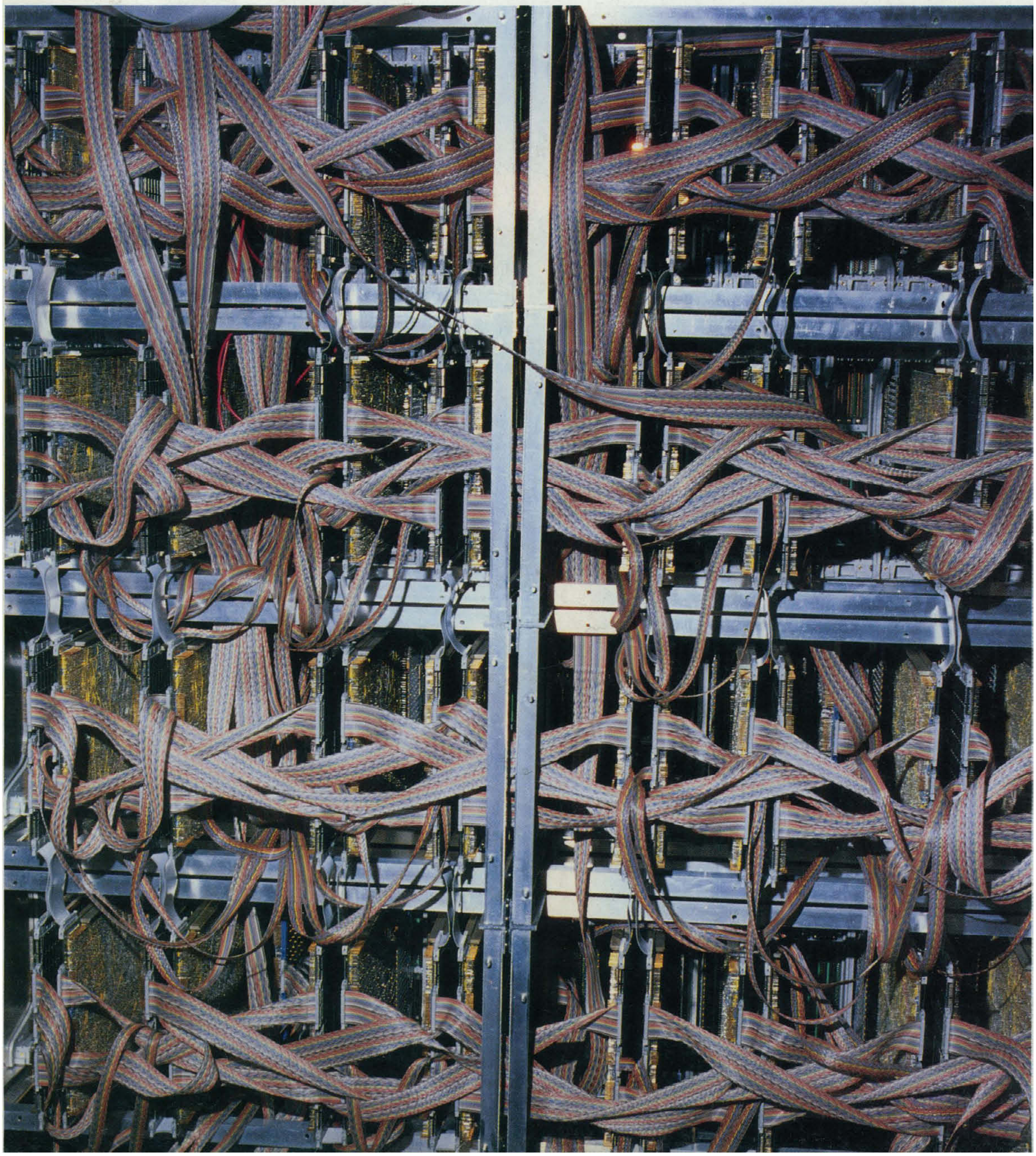

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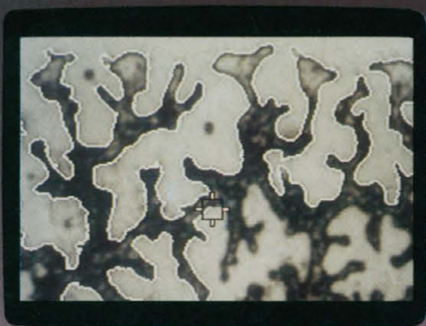
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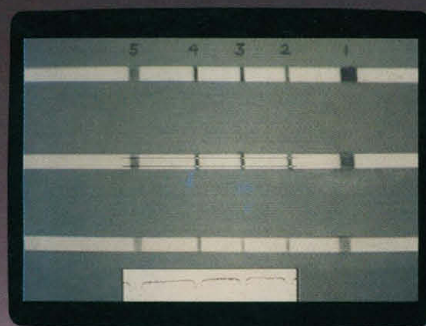
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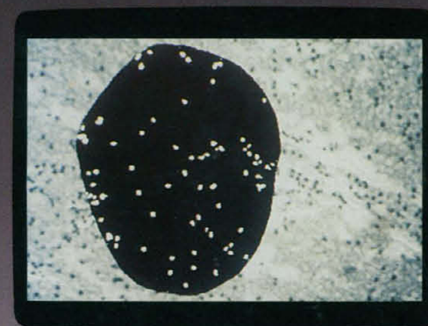
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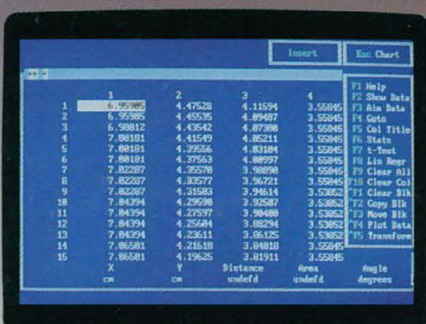
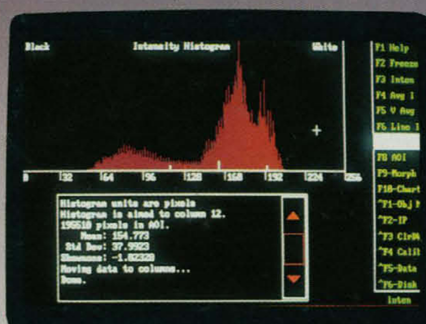

16k x 64k data worksheet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American Association for the Advancement of Science

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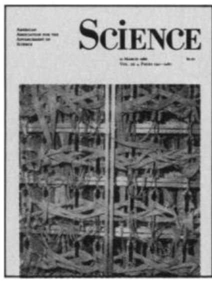
■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of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



COVER A front view of the 1-gigaflop 64-node Columbia Parallel processor showing the edges of the processor boards and the cables connecting them. The cables form a mesh shaped as a doughnut folded twice onto itself. Each wide, multicolored cable is made up of 20 twisted pairs, carrying 16 data bits and parity at a sustained transfer rate of 16 megabytes per second. See page 1393. [Norman H. Christ, Department of Physics, Columbia University, New York, NY 10027]

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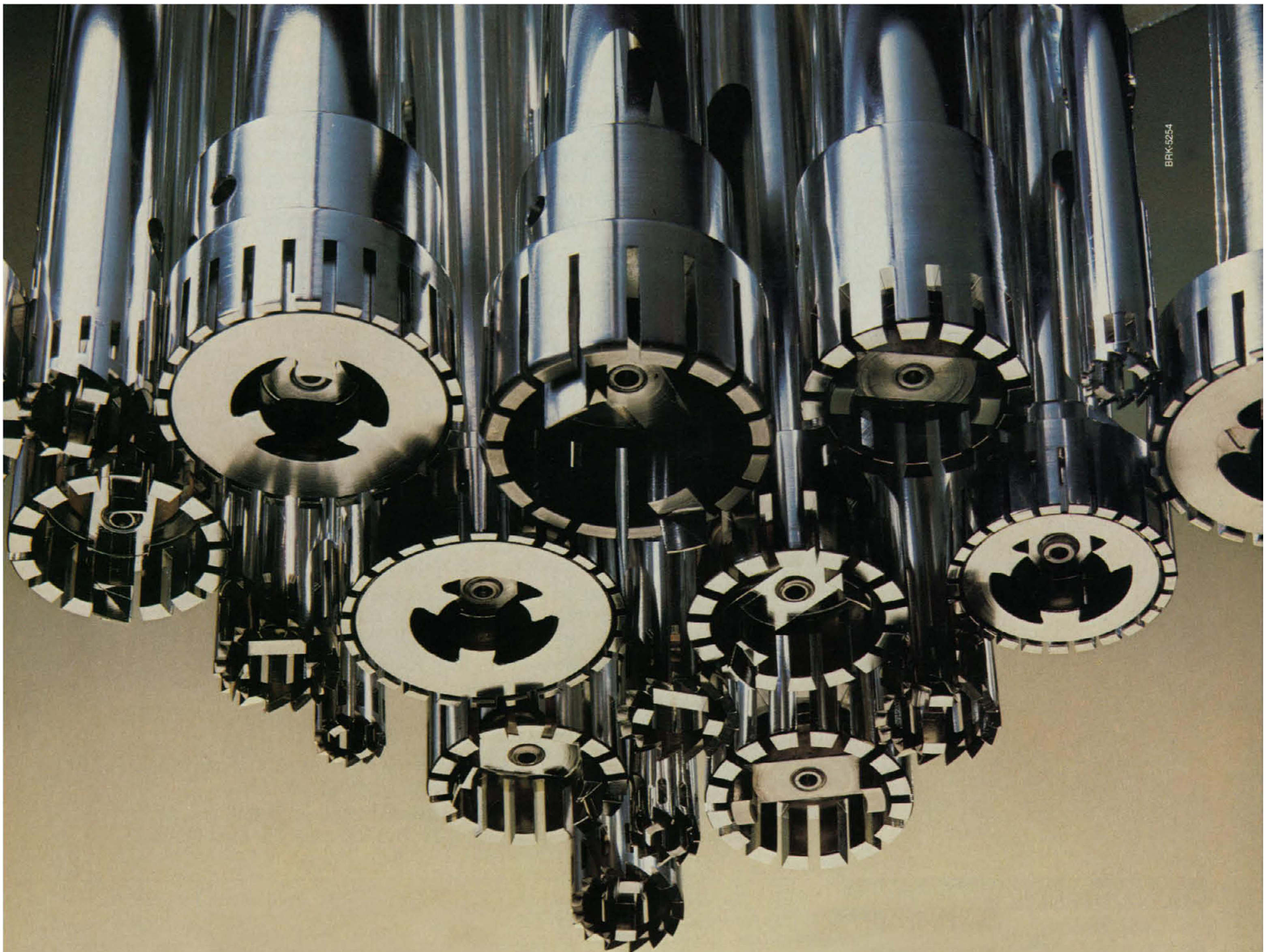
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Golden oldies

FOSSILIZED tree resin (amber) contains bubbles of air trapped at the time that the resin issued forth (page 1406). Berner and Landis studied trapped air samples in amber from mines of four distinct ages; the gases released when the chunks of amber were gently crushed under vacuum were analyzed by quadrupole mass spectrometry. Evidence is provided that the captured gases remain pristine (except for correctable modifications in some bubbles caused by respiration of co-encapsulated microorganisms) and do not exchange with gaseous constituents of the resin itself, the sedimentary rocks in which the amber is preserved, or the modern atmosphere. The oldest amber examined, Manitoba amber, formed during the Late Cretaceous (75 to 95 million years ago); air trapped within it had a high oxygen content (greater than 30%). Air trapped in Baltic amber (from the Eocene or Oligocene, about 40 million years ago) had 21% oxygen, a value similar to that in contemporary air retained within hardened New Zealand resin. Dominican amber (from the Oligocene to early Miocene, about 25 million years ago) had less oxygen than is present in samples of current air. From chunks of amber it may be possible to survey the earth's atmospheric past; how the atmosphere has evolved directly relates to how organic matter has evolved on the earth.

Whittier Narrows earthquake

SEISMIC activity in about 100 known faults and in an additional unknown number of buried thrust faults poses considerable potential earthquake hazard to the greater Los Angeles area (page 1409). One of the buried thrust faults slipped on 1 October 1987, causing an earthquake that was centered near Whittier, California; the earthquake measured 5.9 on the Richter scale, occurred without precursory signs, and caused about $358 million worth of damage without rupturing the earth's surface. Hauksson *et al.* describe the orientation of the fault (north-dipping with an east-west strike), its location in the earth (at a depth of 11 to 16 kilometers), and the first motion along the fault during the earthquake. Faults involved in the aftershocks, the largest of which measured 5.3 on the Richter scale and occurred 3 days after the main shock, are also profiled. The existence of a system of seismically active buried faults in this heavily populated area suggests that estimates of the potential for destructive earthquakes there may be too low.

Versatile RNA

IN the world of molecular biology, the equivalent of the "chicken or the egg" problem is expressed as follows: which came first during evolution—DNA, RNA, or protein (page 1412)? An ideal primordial material would have been self-replicating and would have had both enzymatic and information-encoding properties. A ribozyme derived from pre–ribosomal RNA of the protozoan *Tetrahymena thermophila* appears to be just such a dual-function molecule. Been and Cech show that when this ribozyme and an RNA primer are co-incubated in the presence of dinucleotides, the primer gets elongated. No proteins are required because the ribozyme has the enzymatic activities needed for elongating the RNA chain; a portion of the ribozyme may even serve as a template for the growing chain. Thus, before either DNA or translational machinery was available, an RNA-like material may have been able to carry out all the steps required for replication.

New gene in AIDS virus?

NINE regions with potential protein-coding activity have been identified in the genetic material of the AIDS virus HIV-1 (page 1420). Eight of these regions are situated on the minus strand—the "coding" strand—of the double-stranded DNA intermediate that is synthesized (from viral RNA) inside infected cells; these eight genes encode the gag, env, pol, tat, sor, trs/art, R, and 3′-orf proteins. The putative ninth gene, identified through computer analysis of HIV-1 base-pair sequences, is situated on the other (plus) strand of the DNA intermediate; it is highly conserved, having been found in 11 of 12 HIV-1 isolates. Gene nine has all the features of a genuine gene—a long open reading frame (the transcriptional unit) and flanking promoter sequences and signal sequences for modifying the messenger RNA. Based on predictions of the amino acid sequence (of up to 190 amino acids), the putative protein would be unusually hydrophobic; thus, according to Miller, this protein might associate with membranes. Examples of bidirectional genes are known but rare; finding such a gene in the AIDS virus may provide clues to the pathogenicity of this elusive virus.

Brine shrimp revival

IN response to harsh (anaerobic) environmental conditions, embryos of brine shrimp can enter an extreme but reversible state of quiescence; in this state, their energy flow is 2.4% of their active aerobic metabolic rate, the lowest rate recorded so far for live quiescent invertebrates (page 1425). In their study of the metabolism of brine shrimp embryos, Hand and Gnaiger made continuous microcalorimetric measurements of heat dissipation, recorded respiratory rates, and followed several metabolic products—trehalose, adenosine triphosphate, and adenosine diphosphate. Trehalose, the exclusive catabolic fuel present in preemergence embryos, is considered a likely "pilot light" substance that could be catabolized in tiny amounts in dormant organisms. Dormant embryos might be reactivated in nature when the *p*H increases, just as they are when alkalinization is brought about experimentally. After the simple upward shift in *p*H, catabolism of trehalose may be reinitiated and the organism's metabolism rekindled.

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SCIENCE

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Phenomena at Interfaces

Research opportunities created by the scanning tunneling microscope (STM) and the atomic force microscope (AFM) are being addressed by an expanding number of scientists. As of 1 March 1988, about 400 papers had appeared that dealt with their design or use in studying hitherto unapproachable phenomena. These instruments are capable of lateral resolutions of 1 to 2 angstroms and can measure vertical dimensions to better than 0.05 Å. (Atomic dimensions are of the order of 2 Å.) Initially the STM was employed in studies of objects in high vacuum. But more recently atomic resolution has been obtained with both STM and AFM of solids in air and of solids covered by cryogenic fluids, polar and nonpolar solvents, conductive aqueous solutions, oils, and greases.* These observations demonstrate potential for investigating processes that occur at solid-liquid interfaces. Possible applications include lithography, catalysis, corrosion, electrochemistry, and molecular biology.

Most of the measurements have been made with STM. These studies have revealed many interesting phenomena, including mobility of atoms on surfaces and the reactivity of the dangling bonds that are present at crystalline surfaces. In one type of experiment, a fresh graphite surface in high vacuum was exposed to an amount of silver atoms sufficient to provide a small fraction of a monolayer. Subsequent observation with STM revealed islands of silver atoms on the graphite. It was as if the silver atoms had galloped over the surface to be with their friends. An experiment with crystalline gold testified to mobility of gold atoms near the surface after a crater in the gold three atom layers deep and displacing about 3200 atoms was created. The third level of the crater (25 atoms) was filled with gold atoms in 8 minutes. After 130 minutes, the second level of the crater (900 atoms) was filled. All this occurred at room temperature.

It has long been known that the arrangement of atoms at the surface of a crystal differs from that in the interior. The atoms at the interior are surrounded. Those at the surface are not. As a result, spacing of atoms at the surface is different from that in the bulk. A much noted example is that of silicon (111) which has a 7 by 7 unit cell at the surface each having 19 dangling bonds (dbs) which apparently are quite reactive. When a tiny amount of ammonia is introduced into the vacuum, H and NH_2 are preferentially attached to some particular db but to others more slowly.† Again, this is reactivity at room temperatures.

The STM involves a flow of electricity to or from a sharp tip poised about 10 Å above the conducting surface of a solid. The STM is not readily applicable to insulators or directly useful for mobile biological substances. However, for studies involving conductors, STM is the instrument of choice. It can be made rugged and dependable, and it is already being used in the United States on the shop floor to monitor a production process where precise control of tiny dimensions is paramount to achieving quality of output. It is manufactured commercially with various models costing about $30,000 to $60,000. On the order of 100 instruments have been sold, many of them to the Japanese. In a number of universities, home-made variants have been assembled for as little as a few thousand dollars.

Ultimately, because of its potential versatility, the AFM, invented in 1985, will probably come into broad use, but at present completely satisfactory models are not available. The AFM senses the force between the end of a sharp tip and the atom being observed. The tiny force causes a very small motion in a spring attached to the tip. At present, the typical forces involved when AFM is employed in monitoring are in the range of 10^{-8} newton. (A force of 10^{-8} N is equivalent to the weight of 10^{-6} g.) However, G. Binnig and C. F. Quate have suggested that an apparatus could be developed that would detect a force as small as 10^{-18} N. They point out that already displacements of 10^{-4} Å to 10^{-6} Å have been measured. A displacement of 10^{-6} Å corresponds to about 1 percent of the nuclear diameter.

Behind the success of STM, as well as a good potential future for AFM, is the ability to measure, record, and control displacements of small fractions of an angstrom. This ability is likely to be exploited further in the development of other instruments capable of exploring phenomena at the atomic level.—PHILIP H. ABELSON

*A good sample of activities in STM and AFM will appear in the March–April issue of the *Journal of Vacuum Science and Technology*. †R. Wolkow and Ph. Avouris, *Phys. Rev. Lett.*, in press.

ior. It shares features with many other religions, but most closely resembles Hinduism, which has the ideal of *ahimsā* (respect for life) and demands that its Brahmins be vegetarians.

Thus, by all means, there should be no laws that require antivivisectionists or animal rightists to dissect animals, do research with them, eat meat, use products derived from animals or tested on animals, hunt animals, own pets, attend rodeos, horse races and zoos, or in any other way violate their beliefs.

The separation of church and state, however, also works in the other direction. There also should be no laws that impose the code of the antivivisection religion on the rest of society.

Imagine the public outcry if Brahmins declared that various aspects of American life were immoral according to their religion and successfully pressured Congress to make laws forcing Americans to obey parts of the ethical code of Hinduism. Nevertheless, according to J. F. Rodriguez-Sierra (Letters, 15 Jan., p. 245), "pressures of animal rights activists on some selected congressmen" motivated the new Public Health Service animal guidelines that impose parts of the antivivisection religion. And as the letter from N. D. Barnard (15 Jan., p. 245) illustrates, "the pendulum has only begun to swing the other way" and the animal rightists are now working for a law that would prohibit "even routine research" with animals.

I respect the right of the animal rightists to practice their religion and preach that animals are equal with humans, but I object to any group attempting to get laws to impose its religion on everyone else.

JOHN DAVID SINCLAIR
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Alko, Ltd.,
The Finnish State Alcohol Company,
Post Office Box 350,
SF-00101 Helsinki, Finland

REFERENCES

1. M. Chinnici, *Discover* 8, 42 (1987).

"Macho" Hours

The letter from Carl Djerassi (Letters, 1 Jan., p. 10) and the letters in response (5 Feb., p. 543) really all speak the truth. There is no doubt, as Djerassi points out, that not just adequate, but quality child care as well as domestic help would be great assets to female (and male) assistant professors with children. There is also no doubt that it would be elitist to single out academic women as recipients of government grants to assist in raising families, and that quality institutionalized day care is a desirable goal. Both Djerassi and the letters in response, however, suggest that the "60- to 80-hour macho workweek" is a large component of the reason why it is extremely difficult for female assistant professors to provide adequate attention to their families as well as to their demanding profession. What no one seems to point out is that regardless of profession and gender, to succeed in one's chosen field, whether it is owning a restaurant, law, academic or corporate science, other areas of the corporate world, or any type of business, long hours are necessary to achieve success. Scientists do not really have a monopoly on a 60- to 80-hour macho workweek. That type of effort is what it takes to get somewhere, and no amount of government funding is going to change that.

ALINA C. LOPO
Division of Biomedical Sciences,
University of California,
Riverside, CA 92521-0121

R&D in FY 1989: Looking Ahead in an Election Year

Thirteenth Annual AAAS Colloquium on R&D Policy

14 & 15 April 1988 ✦ Capital Hilton Hotel ✦ Washington, DC

✦ Discussion will be based on ***AAAS Report XIII: Research and Development, FY 1989,*** a timely and comprehensive analysis of the proposals for R&D in the FY 1989 budget, prepared by AAAS and a group of its affiliated scientific, engineering, and higher education associations.

✦ Trends and prospects for R&D in defense, energy, health, space and other areas will be explored by leaders from industry, universities, agencies of the federal government, Congress, the White House, and the scientific and engineering communities.

✦ Perspectives will be provided on topics such as budget deficits and other constraints on R&D programs, setting priorities for science and technology, science advice to the government, evaluation of research, and superconductivity and government's role.

✦ Registrants will also receive ***Proceedings*** following the Colloquium and ***Congressional Action on R&D in the FY 1989 Budget*** in the fall.

Preliminary Program

Thursday, 14 April

8:00 a.m. Registration

8:45 a.m. Welcome

Sheila E. Widnall, *Chairman, Board of Directors, AAAS;* and *Abby Rockefeller Mauze Professor of Aeronautics and Astronautics, Massachusetts Institute of Technology*

Overview of R&D in the FY 1989 Budget

Albert H. Teich, *Head, Office of Public Sector Programs, AAAS;* Stephen D. Nelson, *Manager, Science Policy Studies, AAAS*

9:30 a.m. Budgetary and Policy Context for R&D in FY 1989

Administration proposals for R&D ✦ Overall budget and economic context ✦ R&D community perspectives

Moderator: J. Thomas Ratchford, *Associate Executive Officer, AAAS*

Keynote Address: William R. Graham, Jr., *Science Advisor to the President;* and *Director, Office of Science and Technology Policy, Executive Office of the President*

Speakers: Claudine Schneider*, *Member, U.S. House of Representatives (R-RI); Ranking Minority Member, Subcommittee on Natural Resources, Agriculture Research, and Environment, Committee on Science, Space, and Technology;* Robert K. Dawson, *Associate Director for Natural Resources, Energy and Science, Office of Management and Budget*

12:30 p.m. Luncheon

Address: Bruce Howe*, *Secretary, Ministry of State for Science and Technology;* and *Chief Science Advisor to the Government of Canada*

2:15 p.m. Priority-Setting in an Era of Limits

Federal budget constraints ✦ International economic competition ✦ Priorities in science and technology ✦ Balance between "big" and "small" science

Moderator: Thomas H. Moss, *Dean of Graduate Studies and Research, Case Western Reserve University*

Speakers: Doug Walgren*, *Member, U.S. House of Representatives; Chairman, Subcommittee on Science, Research and Technology, Committee on Science, Space, and Technology;* Erich Bloch*, *Director, National Science Foundation;* Robert Rosenzweig, *President, Association of American Universities;* Joseph A. Saloom, *Senior Vice-President, M/A COM Components, Inc.;* and *Chairman, Council on Research and Technology (CORETECH)*

4:30 and 5:15 p.m. Agency Perspectives on R&D in the FY 1989 Budget (sessions will repeat)

Simultaneous small group sessions ✦ Highlights of major agency R&D budgets ✦ Congressional dis- →

* Invited

cussants ✦ Opportunities for questions and discussion

Department of Defense: Ted G. Berlincourt, *Director, Research and Laboratory Management, Office of the Deputy Undersecretary of Defense for Research and Advanced Technology*

Department of Energy: David B. Nelson, *Executive Director, Office of Energy Research, DOE*

National Aeronautics and Space Administration: Joseph K. Alexander, *Assistant Associate Administrator for Space Science and Applications, NASA*

National Institutes of Health: Jay Moskowitz, *Associate Director for Science Policy and Legislation, NIH*

National Science Foundation: Sandra D. Toye, *Controller, NSF*

6:00 p.m. Reception

Cocktails and hors d'oeuvres ✦ AAAS host

Friday, 15 April

7:45 a.m. Breakfast

Presiding: William G. Wells, Jr., *Science Policy Consultant, AAAS;* and *Professor, Department of Management Science, George Washington University*

Speaker: William Proxmire*, *Member, U.S. Senate (D-WI); Chairman, Senate Appropriations Subcommittee on HUD and Independent Agencies*

9:00 a.m. Major Issues in Science and Technology Policy: Concurrent Sessions

(A) Government's Role in Promoting Science and Its Commercial Applications: Lessons for Superconductivity

Moderator: Mildred S. Dresselhaus*, *Institute Professor, Massachusetts Institute of Technology*

Speakers: Christopher T. Hill, *Senior Specialist in Science and Technology Policy, Congressional Research Service, Library of Congress;* Kay A. Rhyne*, *Program Manager, Defense Advanced Research Projects Agency;* Martha Harris*, *Office on International Affairs, National Research Council*

(B) Top-Level Advice and Policy Coordination in Science and Technology Issues

Moderator: George Bugliarello, *Chairman, Committee on Science, Engineering, and Public Policy, AAAS;* and *President, Polytechnic University*

Speakers: William Golden, *President, New York Academy of Sciences;* and *Treasurer, AAAS;* John P. McTague*, *Vice-President for Research, Ford Motor Company;* and *former Acting Director, White House Office of Science and Technology Policy;* Edward E. David, Jr.*, *President, EED, Inc.;* and *former Science Advisor to the President;* Hugh Loweth, *Former Deputy Associate Director, Energy and Science Division, Office of Management and Budget (Retired);* John Holmfeld, *Study Director, Science Policy Task Force, House Committee on Science, Space and Technology*

(C) Evaluating R&D: The Policy Issues

Moderator: To be announced

Speakers: Daryl Chubin, *Office of Technology Assessment;* S. Alan Heininger*, *Corporate Vice-President for Resource Planning, Monsanto Corporation;* and *President, Industrial Research Institute;* Thomas D. Roslewicz*, *Assistant Inspector General for Audits, Department of Health and Human Services;* James M. McCullough, *Director, Program Evaluation Staff, National Science Foundation;* Norman Braveman, *Director of Program Evaluation, National Institutes of Health*

12:15 p.m. Reception

Cocktails ✦ Cash bar

12:45 p.m. Luncheon

Presiding: Walter E. Massey*, *President, AAAS;* and *Vice-President for Research and for Argonne National Laboratory, University of Chicago*

Speaker: Samuel C. Florman, *Vice-President, Kreisler Borg Florman Construction Company, Scarsdale, NY;* and *author of* ***Blaming Technology, The Existential Pleasures of Engineering,*** and ***The Civilized Engineer***

Concluding Remarks: Alvin W. Trivelpiece, *Executive Officer, AAAS*

2:30 p.m. Adjournment

Use registration forms on following page →

For further details, write: AAAS R&D Colloquium, Public Sector Programs, 1333 H Street, NW, Washington, DC 20005.

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American Association for the Advancement of Science

13th AAAS R&D Colloquium
Washington, D.C.
14–15 April 1988

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$ 8 Breakfast, Friday (15 Apr.) ______

$ 25 Lunch, Friday (15 Apr.) ______

TOTAL AMOUNT: $ ______

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Registration fees include all sessions and publications; meals are included only with payment of full registration fee. All registrants receive *AAAS Report XIII: Research and Development, FY 1989* before or at the Colloquium, published *Proceedings* after the meeting, and a supplementary report, *Congressional Action on R&D in the FY 1989 Budget,* in the fall.

Mail registration form to: AAAS Meetings Office, R&D Colloquium, 1333 H Street, N.W., Washington, D.C. 20005

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