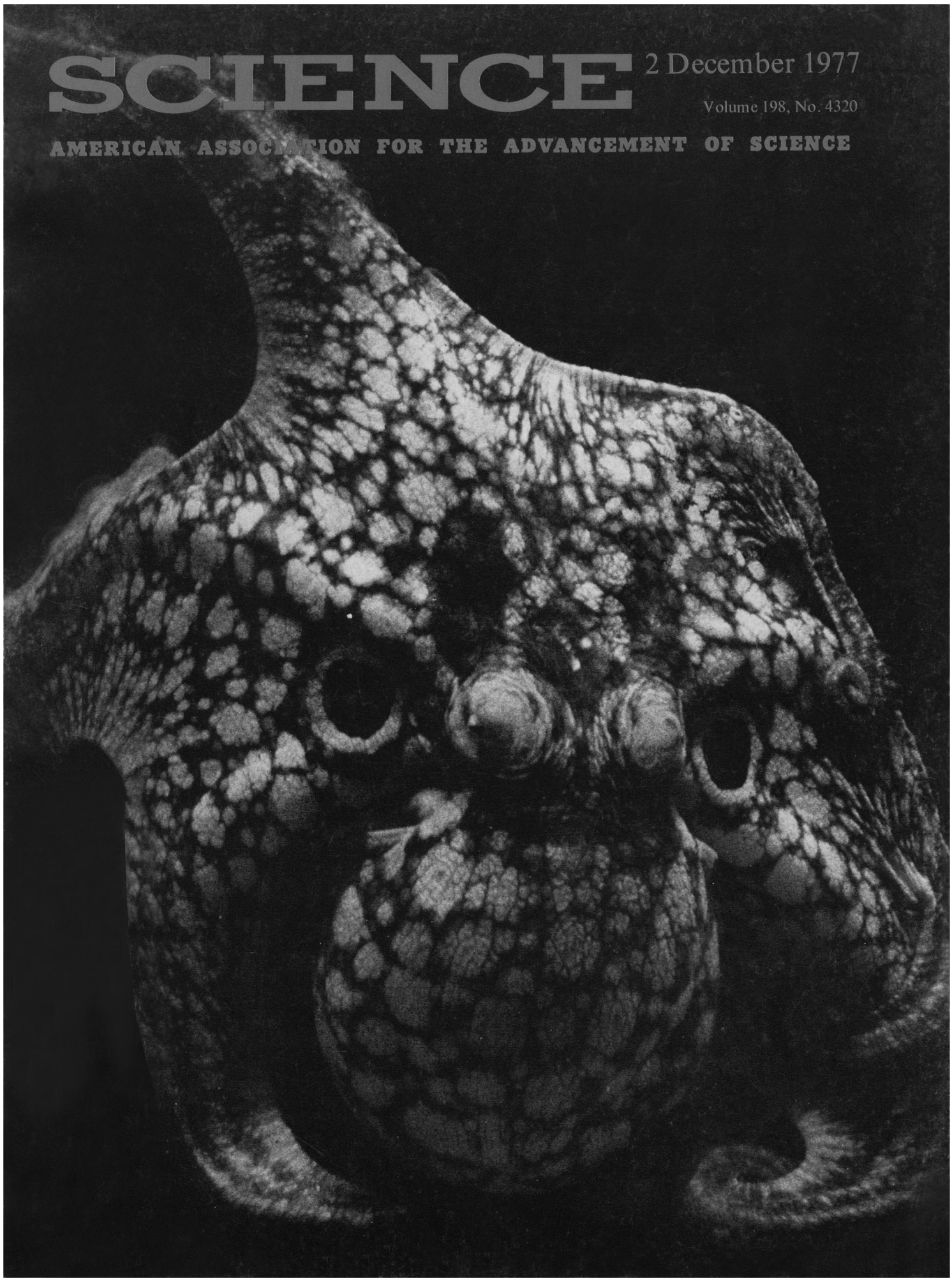
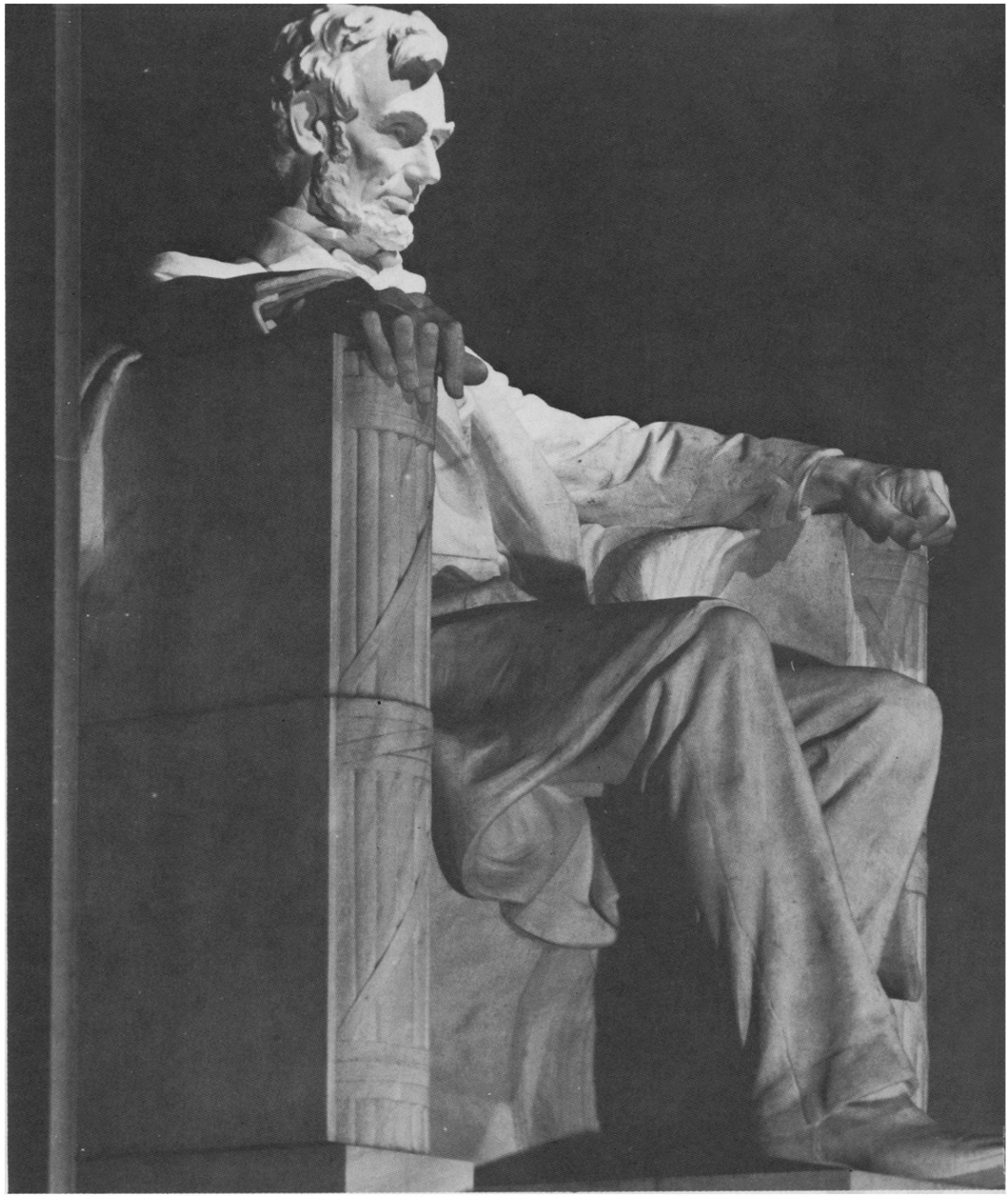
SCIENCE 2 December 1977
Volume 198, No. 4320
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



WASHINGTON



For details about the Meeting program, as well as housing and registration forms, see the Preconvention issue of *Science*, 6 January 1978

or write

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Annual Meeting
Washington
12-17 February 1978

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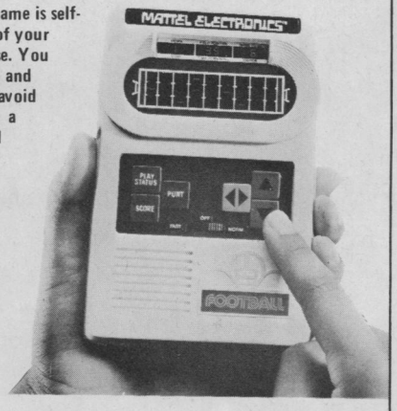

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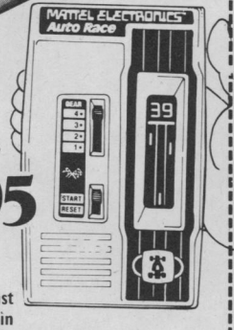

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2 December 1977

Volume 198, No. 4320

SCIENCE

SCIENCE is published weekly, except the last week in December, but with an extra issue on the third Tuesday in September, 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. Member rates on request. Annual subscriptions $60; foreign postage: Canada $10; other surface $13; air-surface via Amsterdam $30. Single copies $2 (back issues $3) except **Guide to Scientific Instruments** $6. School year subscriptions: 9 months $45; 10 months $50. Provide 6 weeks' notice for change of address, giving new and old addresses and postal codes. Send a recent address label, including your 7-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.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Normal specimen of *Octopus hummelincki*, from Haiti, flashing its two ocelli. The terminal part of the female life cycle is controlled by secretions from the optic glands. These endocrine glands control egg maturation, cessation of sex behavior, cessation of feeding, broodiness, and death. Removal of the glands reverses these effects and increases life-span. See page 948. [Robert Jaffee, Brandeis University, Waltham, Massachusetts]

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High resolution and time savings result when the combined advantages of a Sorvall® OTD ultracentrifuge and a Sorvall® vertical rotor are used for density gradient separations.

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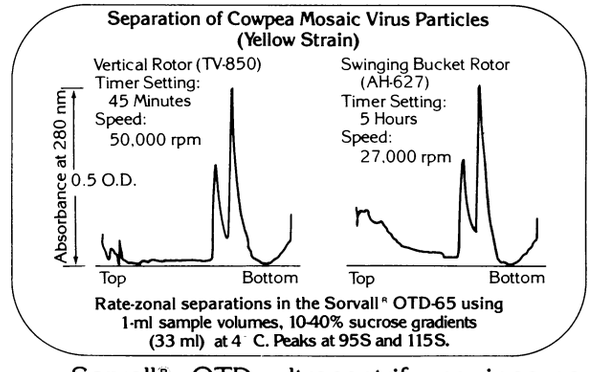
Typical results are shown in the rate zonal separation of cowpea mosaic virus particles using 1 ml samples. Use of a Sorvall® 8-place vertical rotor instead of a 6-place swinging bucket rotor of comparable tube volume reduced spin time more than 80% while maintaining resolution. These rotors are equally suitable for isopycnic density gradient separations.



Rate-zonal separations in the Sorvall® OTD-65 using 1-ml sample volumes, 10-40% sucrose gradients (33 ml) at 4° C. Peaks at 95S and 115S.

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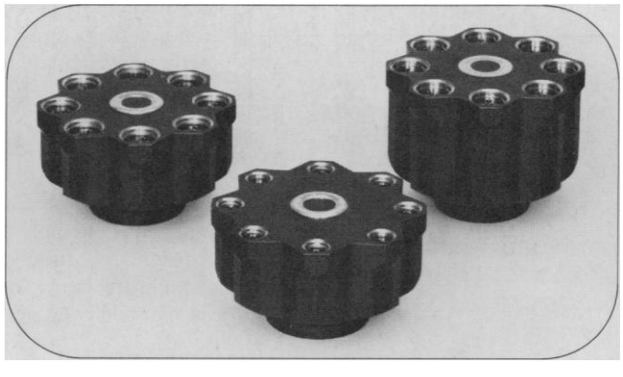

*U.S. Patent 3,998,383

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LETTERS

Sulfuric Acid Emissions from Cars

Thomas H. Maugh's article on the resolution of the automotive sulfuric acid issue (Research News, 21 Oct., p. 280) is a reasonable exposition of the better-publicized projects. However, his implication—that results from two major tests of roadway emissions contributed in a major way to the decision by the Environmental Protection Agency (EPA) not to regulate this pollutant—is incorrect in my view. Results from the two roadway tests were not available when this decision was made.

EPA's Los Angeles Catalyst Study (LACS) and the General Motors (GM) Sulfate Dispersion Experiment were useful in confirming computations of potential ambient air concentrations from measured emission rates from automobiles. However, the essential components were always the emissions factor data themselves, a good model capable of predicting roadway concentrations, and an assessment of the health effects resulting from these concentrations. By comparison with this work, the roadway emissions tests were secondary and mainly needed for improvement of dispersion models.

I would rate the following as the most significant contributions in the sulfuric acid issue: (i) development of a crowded urban expressway driving simulation; (ii) development of effective methods to collect and measure sulfuric acid emissions; (iii) determination of thousands of sulfuric acid emission rates from hundreds of cars in a variety of driving patterns; and (iv) development of effective models to predict ambient concentrations from emissions data and of a method to calculate the probability that a particular ambient level would occur.

Still unresolved is the dilemma of publicity. Seeking media attention for research projects can seriously complicate the process of regulation. As Maugh's exposition demonstrates, some EPA projects not directly involved in rulemaking are more free to advertise and often obtain greater attention.

RONALD L. BRADOW
Mobile Source Emissions Research Branch, Environmental Monitoring and Support Laboratory, Environmental Protection Agency, Research Triangle Park, North Carolina 27711

Emissions data from individual cars and a knowledge of the health effects of sulfates are of little value unless there is an accurate model to show how the sulfates will accumulate near the roadway. The GM study showed that the previous model was grossly incorrect, and the LACS study provided a way to test new models and verify results with individual cars. These studies pull together all the data and thus seem to be the appropriate projects upon which to focus.—T.H.M.

Computer "Therapy"

Perhaps Joseph Weizenbaum's concern about the merits of current or future computer "therapists" (Letter, 28 Oct., p. 354) would be more credible if he did not put words in the mouths of unspecified individuals vaguely described as "a whole generation of workers in that branch of computer science known as artificial intelligence." His statement, "But the to us obvious truth that computers perform calculations and that there are crucial differences between calculations and judgments is dismissed as mere superstition and even species chauvinism . . ." certainly does not represent my opinion, and I am an artificial intelligence researcher. Whether computer programs of any conceivable sort "can actually serve the therapeutic function intended for the client-therapist interaction" is indeed a problematic question. Weizenbaum's attempt to settle this question by fiat ("Lest this mistaken idea be let stand. . .") hardly does it justice. Computers are not people, of that we are sure. Let us admit some ignorance yet about what benefits they may offer and dangers they may pose to society in the future.

JOHN GASCHNIG
Department of Computer Science, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213

. . . Whether a "client" could know or care about or be cared for by a computer is, it seems to me, an empirical question, not one that can be answered by fiat or by reference to a speculative assumption made by a theorist, however persuasive the assumption might be.

An individual's feeling of self-worth or worthiness to be cared about may or may not depend on whether the therapist nourishes emotional processes. For many, the *realization* of the possibility of being worthy may depend more on cognitive processes than on emotional ones. That, too, seems to be an empirical question—one that might, in fact, be investigated by a computer "therapist."

JAMES M. VANDERPLAS
Department of Psychology, Washington University, St. Louis, Missouri 63130

Amorphous Semiconductors

In two recent Research News articles on amorphous semiconductors (26 Aug., p. 851; 9 Sept., p. 1068) there is no direct mention of a feature that is important for both a fundamental understanding and device applications of the most commonly studied of these materials. Namely, their electrical transport properties appear to be quite distinct from those characterizing well-known crystalline semiconductors such as germanium and silicon. In particular, while the charge carriers in these crystals move rapidly, the intrinsic motion of charge carriers in many amorphous semiconductors appears to be extremely slow. For example, at room temperature the mobility of electrons in crystalline germanium is between 10^3 and 10^4 square centimeters per volt-second, while in amorphous germanium it is found to be about 10^{-3} square centimeter per volt-second (*1*). My review (*2*) of experimental evidence from a variety of laboratories indicates that such low intrinsic mobilities characterize amorphous silicon and germanium, the chalcogenide glasses, and transition metal oxide glasses.

One dramatic indication of the difference between the mechanism of charge transport in these amorphous materials and that in the high-mobility crystals is encountered in measurements of the Hall coefficient. In high-mobility crystalline semiconductors the sign of the Hall coefficient is the same as the sign of the predominant charge carrier. However, in the chalcogenide glasses and in amorphous silicon, germanium, and arsenic, the sign of the Hall coefficient is observed to be opposite that of the charge carrier (*2*).

It should also be noted that, in considering devices such as solar cells, the diffusion length in an amorphous semiconductor can be very much shorter than in a high-mobility crystalline semiconductor. It is only 3×10^{-6} centimeter in amorphous germanium (*1*), compared with about 10^{-2} centimeter for the silicon commonly used in solar cells. These short diffusion lengths are likely to affect the design of practical electronic devices.

DAVID EMIN

Sandia Laboratories, Albuquerque, New Mexico 87115

References

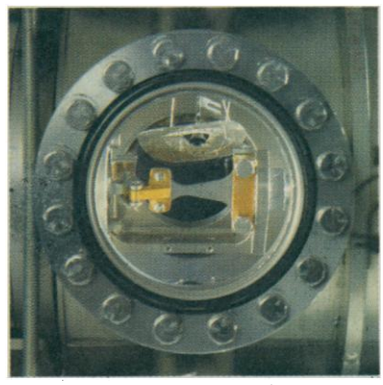
1. T. D. Moustakas and W. Paul, *Phys. Rev. Sect. B* **16**, 1564 (1977).
2. D. Emin, two papers presented at the 7th International Conference on Amorphous and Liquid Semiconductors, Edinburgh, 27 June to 1 July 1977; W. Beyer and H. Mell, paper presented at *ibid.*; P. G. LeComber, D. Jones, W. E. Spear, *Philos. Mag.* **35**, 1173 (1977); D. Emin, *ibid.*, p. 1189.

Forecasting fatigue life... in minutes.

Like the human body, metal too gives early warning signs of failure. One of these, oxide cracking, appears surprisingly early.

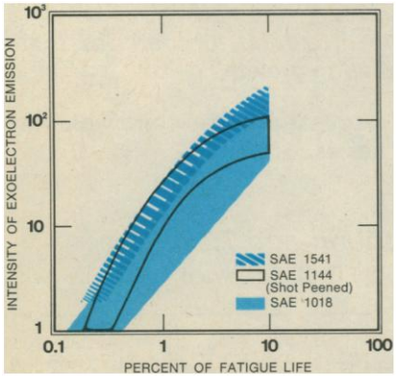
Here at the General Motors Research Laboratories, our physicists are detecting oxide cracks by exoelectron emission measurements. As a result, they have been able to predict—after testing a sample for less than 1% of its fatigue life—when the metal will fail.

How did the basic technique evolve? In exploratory studies, ultraviolet light was used to stimulate exoelectron emission from metal samples being fatigued in a vacuum. Intensity measurements and observations in a photoelectron microscope led to these discoveries:



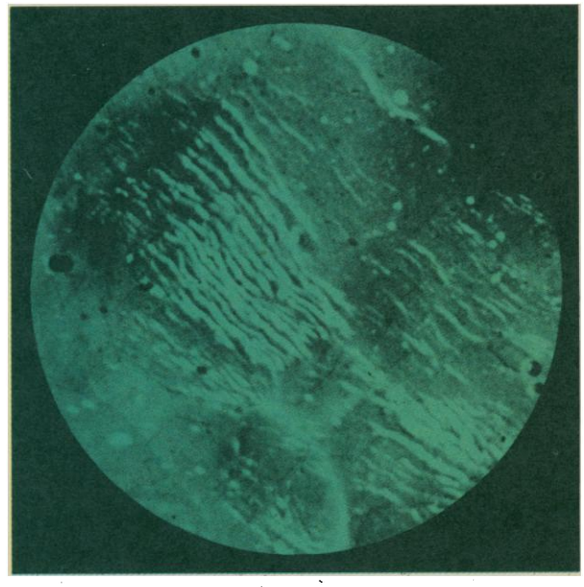
- Exoelectrons flow only from bare metal areas where microcracks have developed in the natural oxide coat, such as the cluster of streaks at right (magnification: 250X).
- The oxide cracks are caused by fatigue damage in the underlying metal.
- Exoelectron emission rate correlates with percent of fatigue life (the graph shows the growth of emission intensities for three types of steel fatigued under different loading conditions).

This correlation is the heart of the prediction. It enables the fatigue life of samples to be forecast in minutes versus weeks for accelerated life tests of components.



What role will the new technique play when perfected? It probably won't replace conventional life testing. But it will serve to establish component designs earlier in the game. And that means a healthy cut in development time.

Predicting fatigue life by exoelectron emission: A scientific approach to a very old engineering problem.



General Motors Research Laboratories
Warren, Michigan 48090

2 December 1977, Volume 198, Number 4320 **SCIENCE**

Will Xerox Kill Gutenberg?

Dead: one small commercial service that made life easier for lazy students. In this news report there is nothing that obviously should worry scientists and scholars; yet trouble can first appear as "a cloud no bigger than a man's hand."

For 40 years a student-founded business near the Berkeley campus of the University of California supplied "Fybate Lecture Notes" to students who were unwilling or unable to take adequate notes. Graduate students earned money working for Fybate. Many professors cooperated by correcting the final draft. The enterprise filled a need, it gave employment, and it satisfied the customers. Why did the system collapse?

Xerography was the culprit. Fybate Notes were copyrighted, but students copied them and thus evaded paying their share of production costs and profits. The word "profits" has a bad press in our day; many students find virtue in preventing them. So the goose has been killed: there will be no more Fybate originals to copy. One can argue that the change is educationally for the better; but will the fate of Fybate next overtake books and journals?

When modern copiers were new, copies cost 10 cents or more per sheet, and few scientific books cost more than 3 cents per page. It was then silly to copy a book still in print. Now the economics are reversed. The cost of the 43 "Books Received" listed in *Science* for 28 October 1977 averages out at 7.1 cents per page. The most expensive item, *Transient Waves in Visco-Elastic Media*, costs 17.6 cents per page. Copying costs only 3 cents a sheet, and sometimes two book pages can fit on a single sheet, halving the cost. A really expensive book may be copyable for one-tenth its purchase price.

Unauthorized copying of copyrighted material is theft, but who among us can claim more than Hamlet, who said, "I am myself indifferent honest"? The higher book prices go, the less we hesitate to infringe copyrights. We face a textbook example of the destructive force of positive feedback. Original publication, with its expensive editorial and typographic costs, is markedly subject to economies of scale. In contrast, the cost of xerographing individual copies is nearly constant. Every increase in the economic advantage of xerography encourages more copying and less buying of books; this increases the price of future books published, encouraging more copying, which raises the price further. Are you willing to pay 17.6 cents per page for a book? How about 50 cents? Or a dollar? Publishers are caught in a vicious spiral.

Those who understand the danger best—authors and publishers—may hesitate to speak, knowing their arguments will be labeled "self-serving"—as indeed they are. But if the author were to give up his royalty the price per page would drop only to about 6.4 cents; and if the publisher followed suit, the price might fall as low as 5.7 cents. This would still be almost twice the price of xerography. The dynamics of the positive feedback system would be unaltered. How much longer can scholarly books and journals be published?

Must the gift of the Gutenberg be nullified by the new technology? Or can we devise an institutional defense against the imminent bibliocide? The floor is open to suggestions.—GARRETT HARDIN, *Department of Biological Sciences, University of California, Santa Barbara 93106*

Annual Meeting
Washington
12-17 February 1978

Meeting Program—Part I

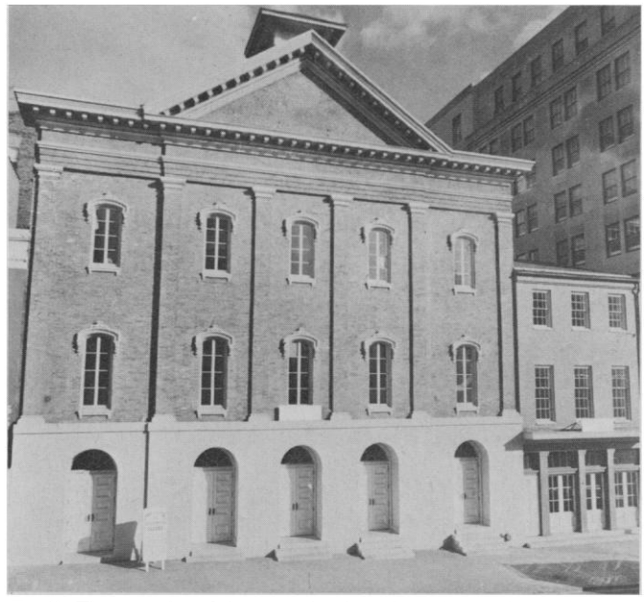
For further details, see the Preliminary Program, *Science*, 4 November, pages 489 to 495, and Tours and Cultural Events, *Science*, 18 November, pages 718 and 719.
HOTEL CODES: Sheraton-Park . . . SP; Shoreham Americana . . . SA.

Next year we will celebrate the 130th anniversary of our Association and in February we will have our 144th national meeting, the 10th to be held in the nation's capital. The meeting will be a large and exciting one, with 10 public lectures, 136 symposia encompassing 180 half-day (3-hour) sessions, 48 sessions of contributed papers, a Science Film Festival, several scientific tours of facilities in the Washington area, and an exhibit which will explore the various aspects of the "Tools of Science."

Listed below are the 49 symposia of general interest and of interest in the physical sciences and engineering. The symposia in the life and social sciences will appear in the 16 December issue of *Science*; those in the areas of science policy and education will appear in the 23 December issue. The preliminary program for the meeting has appeared in the 4 November issue and information about tours in the 18 November issue.

Look over this material, as well as the material to be presented later this month; we are sure that you will find many things of great importance and interest to you. Plan to be with us in February; fill out and send in the housing and registration forms on pages 914 and 915 and be sure of your place at this important event.

—ARTHUR HERSCHMAN



Ford's Theatre, site of the assassination of President Lincoln in 1865. Closed for many years, this building is once again a legitimate theater. [Washington Area Convention and Visitors Bureau]

1. General Interest

The Frontiers of the Natural Sciences (13 Feb., SP): Biology, geothermometers, physics, chemistry, geometry, astronomy.
Rolf M. Sinclair, James A. Krumhansl, Thomas Eisner, Anita G. Harris, D. Allan Bromley, Norman Hackerman, Frederick J. Almgren, Jr., Frank D. Drake.

Recombinant DNA: Current Status of Regulatory Legislation (13 Feb., SP): NIH Guidelines, legislation at federal, state, and local levels.
Clifford Grobstein.

Blacks in Science, Medicine, and Invention (14 Feb., SA): Physicists, Carver to Hill, mathematics, biology and medicine, invention.
Ronald E. Mickens, Carl Spight, Joseph A. Johnson, III, Samuel P. Massie, James A. Donaldson, John M. Browne, Robert C. Hayden.

Sociobiology: Beyond Nature-Nurture (14 and 15 Feb., SP): New synthesis, social organization, behavior, cultural determinants, male bias, hormones and gender, reproduction, sexual behavior, life-history characteristics, nepotism, kin selection, parent-offspring, natural selection, limitations of analysis, research, theory.
George W. Barlow, James Silverberg, David L. Hull, Stephen T. Emlen, John C. DeFries, Frank B. Livingstone, Stephanie A. Shields, Jane B. Lancaster, Elizabeth K. Adkins, George C. Williams, Richard Dawkins, Robert R. Warner, Marcia Guttentag, Paul W. Sherman, William G. Irons, Napoleon A. Chagnon, Bobby Jo Williams, Judy A. Stamps, Robert A. Metcalf, Margaret Mead, Stephen J. Gould, David P. Barash, Eleanor Leacock, Edward O. Wilson, Arthur L. Caplan.

Science and the Science-Fiction Writer (15 Feb., SA):
Rolf M. Sinclair, Ben Bova, David Gerrold, Frank Herbert.

Participation of Women and Men in Scientific Research (15 Feb., SP): Data, experiences, sociological variables.
Michele L. Aldrich, William D. McElroy, Betty M. Vetter, Virginia Walbot, Cora Marrett, Charles Odegaard, Carlos Kruytbosch.

AAAS Awards Session (15 Feb., SP): AAAS-Newcomb Cleveland, AAAS Socio-Psychological, AAAS-Rosenstiel.

Genes and Gender (16 Feb., SP): Primates, animal versus human, aggression, brain asymmetry, transsexualism.
Ruth Hubbard, Marion Lowe, Lila Leibowitz, Ruth Bleier, Freda Salzman, S. Leigh Star, Janice G. Raymond.

Risk Assessment Using *E. coli* for Recombinant DNA Techniques (16 Feb., SP): Host-vector systems, NIH guidelines, legislative regulation.
Clifford Grobstein, Sherwood L. Gorbach, Roy Curtis III.

Stress (17 Feb., SP): Determinants of control, coronary disease, job loss, somatic illness, helplessness, depression.

Jerome E. Singer, Barbara S. Dohrenwend, David C. Glass, Stanislav V. Kasl, Sidney Cobb, John W. Mason, Hans Selye, Richard S. Lazarus, Martin E. Seligman, Suzanne Miller, Jay M. Weiss.

2. Energy

The Impact of the Geosciences on Critical Energy Resources (13 Feb., SA): Federal objectives, university programs, hydrocarbon, coal, geothermal, nuclear, environmental impact.

C. A. Burk, C. L. Drake, Harrison H. Schmitt, Peter T. Flawn, J. D. Moody, Jack A. Simon, W. L. Fisher, Leon T. Silver, Priscilla C. Grew.

Efficient Comfort Conditioning (Heating and Cooling) of Buildings (13 Feb., SP): Solar, OTA evaluation, market acceptance, economic analysis, storage, cogeneration, community systems, load management, community storage, urban areas, HUD experience, Sweden.

Walter G. Berl, W. Richard Powell, Frederick H. Morse, Henry Kelly, Gerald E. Bennington, Peter C. Spewak, Robert T. Crow, J. G. Asbury, J. V. Caruso, R. S. Giese, Ronald O. Mueller, Karl W. Böer, Gerald S. Leighton, Robert G. Uhler, James R. Powell, Jerome H. Rothenberg, Lee Schipper.

The Socioeconomic Impacts of Energy Development (13 Feb., SP): Social impacts, Western energy development, boomtown, nuclear.

Frank Clemente, Stan L. Albrecht, Ronald L. Little, William R. Freudenburg, Richard S. Krannich.

New Batteries in Energy Use of the Future (14 Feb., SP): Ionic transport, sodium-sulfur, lithium-titanium disulfide, load leveling.

Reuben S. Title, Robert A. Huggins, Walter L. Roth, Robert P. Hamlen, Lewis H. Gaines, James R. Birk.

Economic Growth With/Without Energy Conservation (14 Feb., SP): Imperative of conservation, full employment, economic well-being, GNP, post-petroleum prosperity, capital stock.

Charles J. Hitch, John H. Gibbons, Chauncey Starr, Walt W. Rostow, Joel Darmstadter, Mike McCormack, Denis Hayes, Alan S. Manne, Roger W. Sant.

Renewable Energy Resources: Modeling of Complex Realities (14 Feb., SP): Tidal power, wind energy, economic growth, potential markets.

Maxine L. Rockoff, Edward H. Blum, George F. D. Duff, Marvin R. Gustavson, William W. Hogan.

The Report of the National Academy of Sciences' Committee on Nuclear and Alternative Energy Systems (15 Feb., SP): Demand and conservation, alternative supply, energy modeling, risks and impacts, nuclear energy.

Harvey Brooks, Edward L. Ginzton, Jack M. Hollander, John H. Gibbons, W. Kenneth Davis, Floyd L. Culler, Jr., Lester B. Lave, Tjalling C. Koopmans, James Crowe, John Harte, David Sills, Bernard I. Spinrad, David Rose, John P. Holdren.

Exploring Rationale for Long-Term R&D Investments in Inexhaustible Energy Resource Technologies (16 Feb., SP): Solar, federal role, timing and selection, global context, technology investments.

Robert Nathans, Stephen Rattien, Bennett Miller, Robert L. Hirsch, Allen L. Hammond, James W. Howe.

Life-Cycle Costing in Energy Conservation (16 Feb., SP): Conversion technologies, zero growth, transportation, industrial technologies, realistic goals.

S. S. Penner, John A. Belding, Eric Hirst, Henry L. Stadler, John H. Gibbons, N. B. McEachron, D. C. Hall, L. F. Lewis, T. V. Long.

Federal Energy Policies: Future Directions (17 Feb., SP): Energy goals, nuclear policy, international perspective, research and development.

John C. Sawhill, Frank Zarb, Joseph S. Nye, Melvin Conant, Robert Fri.

3. Tools of Science

Photography and Imaging as Tools of Science (13 Feb., SP): CT scanning, noninvasive dissection, radionuclide imaging, angiography, videotape in medicine, pediatric endoscopy, polar oceans, deep sea research, the U.S.S. Monitor, space technology, high-speed photography, holography.

W. E. Garrett, Bryan Hodgson, Julie Gamble, John M. Keshishian, David O. Davis, Richard A. Robb, Nicholas G. Nolan, H. Brandis Marsh, Hans H. Schneider, Stephen L. Gans, Timothy W. Kennedy, Joseph B. MacInnis, Robert D. Ballard, Emory Kristof, Harold E. Edgerton, Robert E. Kutzleb, James R. Edberg, Gregory A. Dale, David R. Scott.

Computers as Tools in Science (14 Feb., SP): Intelligent instruments, languages, neurobiology, the future, pattern recognition, synthesis, diagnostic cytologies, data base management.

Raymond E. Dessy, James T. Arnold, Howard Moraff, Paul B. Brown, Richard Case, Peter C. Jurs, W. Todd Wipke, Peter H. Bartels, George L. Wied, Martha Williams.

New Tools for Viewing the Universe (15 Feb., SP): Optical, infrared, and space telescopes; radio astronomy; x-ray.

Beverly T. Lynds, Morton S. Roberts, William E. Howard, III, Leo Goldberg, Charles H. Townes, David S. Heeschen, Noel W. Hinners, Lyman Spitzer, Jr., Edwin M. Kellogg.

Patterns of Invention (16 Feb., SP): Cyclotrons, maser, laser.

Rolf M. Sinclair, M. Stanley Livingston, Charles H. Townes.

The New Ion Microscopies: Progress and Prospects (16 Feb., SP): Proton microprobe, high resolution, secondary-ion microprobe.

Walter L. Brown, Paul Horowitz, Riccardo Levi-Setti, George R. Ringo.

Mathematics: Tool of Science (17 Feb., SP): Physical sciences, life sciences, industrial setting, undergraduate program.

Alfred B. Willcox, Peter D. Lax, Robert M. May, Gordon Raisbeck, Maynard D. Thompson.

Research Reporting with Tomorrow's TV and Computer Graphics (17 Feb., SP): Visual literacy, interactive telecommunication, computer-to-computer communication.

David Triantos, Frederick R. Broome, Lawrence E. Cornish, Francis M. Dwyer, Peter Clarke, Martin Elton, Peter C. Goldmark, S. Joseph Campanella, Richard Maynard, Bruce Cornwell, James Johnson, Murray Turoff, S. Roxanne Hiltz.

4. Engineering and Technology

Macroengineering Projects: The Infrastructure of Tomorrow (13 Feb., SP): Historical perspectives, the environment, model neighborhood, planning, finance, the oceans, transplanetary subway systems, solar power satellites, asteroid capture.

Frank P. Davidson, Lawrence J. Giacoletto, Robert Salkeld, Eugene S. Ferguson, Howard Margolis, Frank Laird, Peter Land, Richard Godwin, W. Kenneth Davis, Wallace O. Sellers, Louis E. Alfeld, Mel Horwitch, George Kozmetsky, Brian N. Quick-

stad, Charles J. Ryan, J. Vincent Harrington, Robert M. Salter, Peter E. Glaser, Brian T. O'Leary, Philomena G. Grodzka, A. Ranger Curran, David Fromkin, William J. Jones, Philip J. Pocock, A. George Schillinger, Ellis L. Scott, Michael Telson.

Hypergraphics: Visualizing Complex Relationships in Art, Science, and Technology (14 Feb., SP): Applied science, four-dimensional geometry, visual comprehension, N-dimensional geometry.

David W. Brisson, Steve M. Slaby, Thomas F. Banchoff, Charles M. Strauss, Gregg Edwards, Cyril Stanley Smith.

Corrosion: The Silent Scourge (14 Feb., SP): Societal consequences, museum research, economic effects, corrosion research, corrosion technology.

William R. Prindle, Roger W. Staehle, Martha Goodway, Elio Passaglia, Jerome Kruger, M. Brian Ives.

Appropriate Technology: Panacea for Developing Nations? (15 Feb., SP): A Mexican community, agricultural colleges, development, USAID.

Katrina L. Eadie, David G. Cartano, Cynthia Hewett de Alcantara, Milton Morris, A. Eugene Havens, Reed Hertford, Alexander Firfer, Witold Rybczynski, Martin Pineiro.

Effects of Changing Social Priorities on Engineering and Technology in the United States and Abroad (16 Feb., SP): Consumer, university, opportunities for technology, global politics, developing countries, engineering schools.

George Bugliarello, A. George Schillinger, Lewis M. Branscomb, William F. May, William Linvill, Edward Werk, Jr., N. Bruce Hannay, Harlan Cleveland, Richard S. Eckaus, Robert P. Morgan.

The Role of Technology in Changing the International Economic Order (17 Feb., SP): World economy, automotive industry, energy, electronics, Atlantic community.

Jack Baranson, Christian N. Kristoff, Edward J. Gornowski, John B. Arnold, John H. Hoagland, Sergio C. Trindade, Makarand V. Dehejia.

Appropriate Technology in the Developed Countries: The Macro and Micro Sides of It (17 Feb., SP): Developing nations, the environment, structural basis, farm equipment, low-income people, chemicals.

Allen Jedlicka, Robert M. Pierson, John F. Seiberling Jr., Beth Hagens, Gordon H. Millar, James Schmidt, William R. Nummy, Thomas H. Fox, John F. Clark, Joseph F. Coates, Steven Palincsar, William R. Ludka.

5. Physical Sciences

Gravitational Physics—A New Window for Exploration (13 Feb., SP): Gravitational wave, gravitational interaction.

William O. Hamilton, Joseph Weber, Kip S. Thorne, Irwin S. Shapiro, Carroll O. Alley, L. S. Cutler, R. A. Reisse, R. E. Williams, J. D. Rayner, C. A. Steggerda, J. V. Mullendore, S. Davis, L. Small.

Progress in X-ray Astronomy—First Results from HEAO-1 (13 Feb., SP): X-ray sky, diffuse component, optical and radio counterparts, high energy.

Herbert Gursky, Frank B. McDonald, Herbert Friedman, Elihu A. Boldt, Laurence E. Peterson, Walter H. G. Lewin, Jeffrey A. Hoffman, Wallace L. W. Sargent.

The Search for Extraterrestrial Intelligence: Priority or Pandora's Box? (14 Feb., SP): Astronomical perspective, life in the universe.

Alan M. Ladwig, Leonard W. David, Richard Berendzen, Carl Sagan, Richard Young.

Humans in the Cosmos (15 Feb., SA): Sun and climate, orbital variations, interstellar dust clouds, supernovae.

Gerrit L. Verschuur, J. Murray Mitchell, Jr., James D. Hays, Raymond J. Talbot, Jr., Malvin A. Ruderman.

Prospects for Life in the Universe: The Ultimate Limits to Growth (15 Feb., SA): Industrialization of space, space settlement, long-term growth, intelligent life.

William A. Gale, Jesco von Puttkamer, Brian T. O'Leary, Freeman J. Dyson, Gregg Edwards, Carl Sagan, Michael Michaud.

Picosecond Lasers in Chemistry (16 Feb., SP): Radiationless

processes, bacterial photosynthesis, electronic relaxation, radiation chemistry, exciton migration and annihilation.

Kenneth B. Eisenthal, William Spindel, Norman Metzger, Charles V. Shank, E. P. Ippen, Maurice W. Windsor, Dewey Holton, Peter M. Rentzepis, John W. Hunt, Stanley L. Shapiro, A. J. Campillo.

Science for the Naked Eye: Or the Physics of Everyday Experience, V (17 Feb., SP): Lasers and art, insect's view, earth from above, karate, before Columbus, moving about.

Rolf M. Sinclair, Stephen A. Benton, Thomas Eisner, Georg Gerster, Michael S. Feld, Ron McNair, David Feld, Jonathan Feld, Anthony F. Aveni, Vance A. Tucker.

6. Climate and Land Use

Impacts of Recent Weather Extremes in the United States (13 Feb., SA): Recent drought, 19th-century precedents, cold winter, water resource problems, agriculture.

J. Murray Mitchell, Jr., Donald L. Gilman, David M. Ludlum, Norton D. Strommen, Ronald B. Robie, Phillip F. Sisson.

The Scientific Basis of Modern Weather Forecasting (13 Feb., SA): Physical methods, statistical methods, benefits to the public, atmospheric modeling, prediction.

Frederick G. Shuman, Norman A. Phillips, Cecil E. Leith, George P. Cressman, Joseph Smagorinsky, Edward N. Lorenz.

Hail Suppression, Impacts, and Issues: A Technology Assessment (14 Feb., SA): Economic impact, future research, policy issues.

Barbara C. Farhar, Stanley A. Changnon, Jr., C. Robert Taylor, Jon van Blokland, Steven T. Sonka, Dean E. Mann.

Remote Sensing Applied to Meteorology and Hydrology (14 Feb., SA): Ground-based, numerical models, satellite and radar data.

David S. Johnson, C. Gordon Little, Verner E. Suomi, Vincent J. Oliver, Vincent V. Salomonson, Eugene L. Peck, Donald R. Wiesnet.

Whither LANDSAT? Future Directions for Earth Observation Data Management Systems (15 Feb., SA): Environmental information, industry's view, remote sensing, economics and policy.

Lester F. Eastwood, Jr., Christopher T. Hill, Daniel P. Fink, A. Donald Goedeke, Charles K. Paul, Robert P. Morgan.

Desertification: Issues in Measuring and Monitoring the Process with Indicators (15 Feb., SA): Plant species, social indicators, developed economies, Mexican experiment.

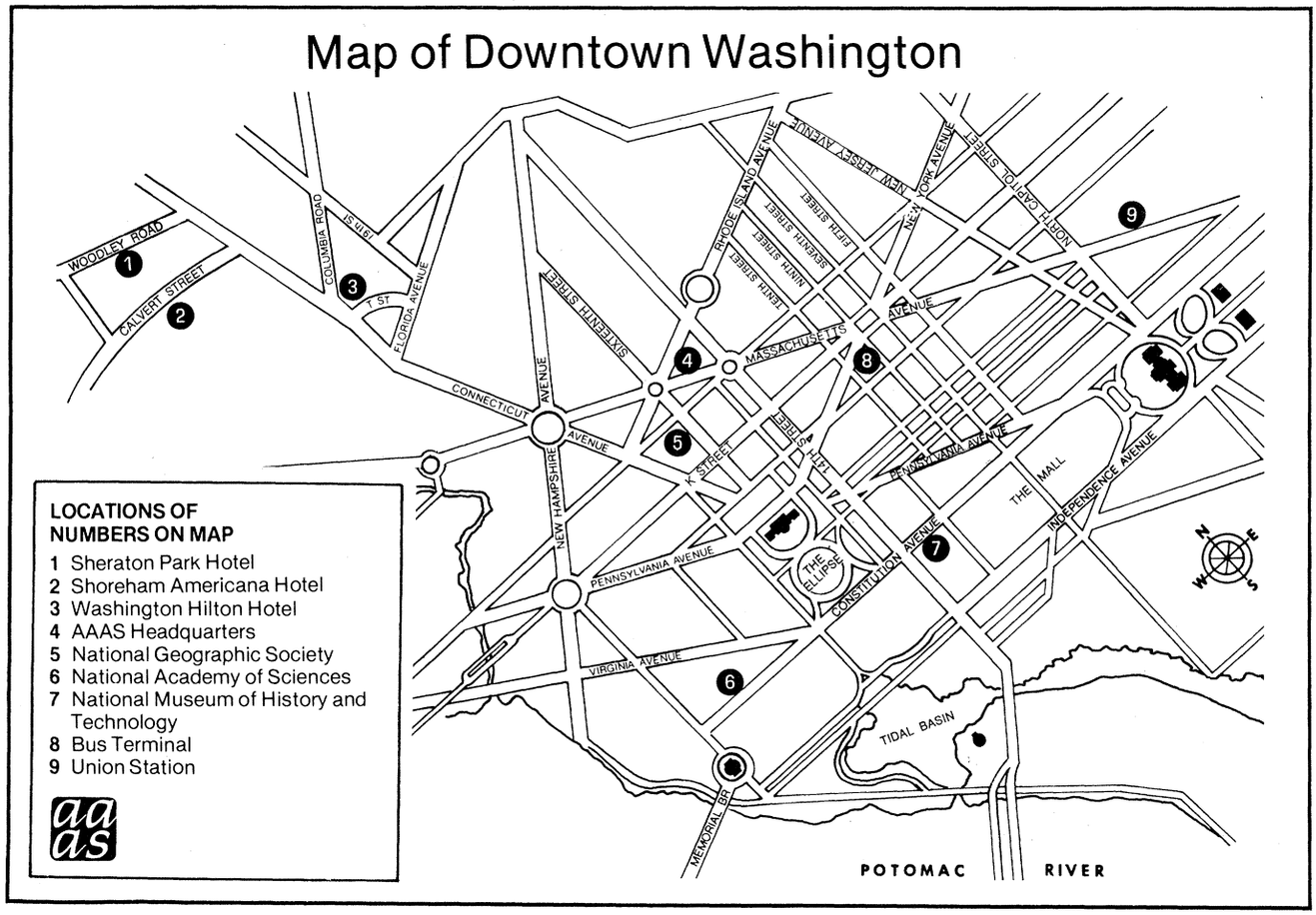
Priscilla Reining, Elinor Terhune, Brian Spooner, John W. Bennett, Martin H. Gonzalez.

Assessing Natural Resources: Science, Land Use, and Public Policy (16 Feb., SA): Great Britain, states survey, Canada, U.S. Geological Survey, power plants, mine reclamation, irrigation survey, floods, dams, San Francisco, Connecticut.

James R. Balsley, Harold L. Burstyn, Ellis Y. Yochelson, Douglas A. Bassett, Michele L. Aldrich, Morris Zaslow, Henry W. Coulter, Edgar A. Imhoff, John Alexander Williams, Donald M. Thomas, Robert D. Brown, Hugo Thomas.

Climatic Futures (17 Feb., SA): Climatic fluctuations, limits to growth, prediction, models, geological record.

Robert M. White, Helmut E. Landsberg, Stephen H. Schneider, Syukuro Manabe, John Imbrie, Reid A. Bryson.



Annual Meeting Washington
12-17 February 1978

Advance Registration Form
(C)

ENCLOSED IS:

AAAS Member: ☐ $24 Single Registration Fee ☐ $36 Double Registration Fee (attendant and spouse)

Non-Member: ☐ $30 Single Registration Fee ☐ $42 Double Registration Fee (attendant and spouse)

Student: ☐ $12 Single Student Registration Fee ☐ $18 Double Registration Fee (student attendant and spouse)

Non-Member applying for AAAS membership* and meeting registration: (Annual membership dues include 52 issues of SCIENCE. Double membership—individual and spouse—includes one subscription to SCIENCE.)

☐ $52 Single Registration and Membership ($24 registration and $28 dues)

☐ $64 Double Registration and Single Membership (name of applicant _____)
($36 registration and $28 dues)

☐ $76 Double Registration and Membership ($36 registration and $40 dues)

*These rates apply to USA membership only. Inquire for Canadian or Foreign rates.

Program and badge will be mailed to each registrant in mid-January.
Registrations received after 20 January will be held at the AAAS Information Booth.

NAME OF REGISTRANT: _____
(Last Name) (First and Initial)

NAME OF SPOUSE REGISTRANT: _____
(Last Name) (First and Initial)

REGISTRANT'S MAILING ADDRESS: _____
[For receipt of program(s), badge(s), and SCIENCE (for new applicants)] (Street)

_____
(City/State) (Zip Code)

ADDITIONAL REGISTRANTS: _____
(With same mailing address. Use new form if address differs)

REGISTRANT'S INSTITUTION OR COMPANY: _____

_____ | | | | | |
(City) (State) (Zip Code)

Check days attending: Sun ☐ Mon ☐ Tue ☐ Wed ☐ Thu ☐ Fri ☐

CONVENTION ADDRESS: _____
(Where you can be reached) (Hotel or Street Address)

Note: Special one-day attendance registration is available at the Meeting Registration Desks ($12 regular, $6 student).
A book containing the abstracts of the Meeting papers will also be available at the Registration Desks at an additional charge of $5.

☐ **Please check here if you need special services due to handicap. We will contact you prior to the meeting.**

Mail to: American Association for the Advancement of Science, Dept. R,
1515 Massachusetts Ave., NW, Washington, D.C. 20005

SURVEY OF ATTENDANTS
Annual Meeting, Washington, 12–17 February 1978

Your answers to the following questions will help us in planning future AAAS Annual Meetings. Please complete the following form and either return it with your registration form or send in separately (to the same address) if you wish to respond anonymously (in any case, the two forms will be processed separately).

Principal Professional Interest
- 11 ☐ Physical, mathematical
- 12 ☐ Biological, medical
- 13 ☐ Engineering
- 14 ☐ Social, behavioral
- 15 ☐ Science policy
- 16 ☐ ..... (other)

Principal Professional Activity
- 21 ☐ Teaching, education
- 22 ☐ Health practice
- 23 ☐ Other practice, consulting
- 24 ☐ Research, development
- 25 ☐ Administration
- 26 ☐ ..... (other)

Institutional Affiliation Type
- 31 ☐ University, 4-year college
- 32 ☐ Other educational
- 33 ☐ Industrial, commercial
- 34 ☐ Other private
- 35 ☐ Government
- 36 ☐ ..... (other)

Highest Educational Level
- 41 ☐ Doctoral Degree
- 42 ☐ Master's Degree
- 43 ☐ Other professional
- 44 ☐ Bachelor's Degree
- 45 ☐ ..... (other)

Age
- 51 ☐ Under 26 years
- 52 ☐ 26 to 35 years
- 53 ☐ 36 to 45 years
- 54 ☐ 46 to 55 years
- 55 ☐ 56 to 65 years
- 56 ☐ Over 65 years

Distance Traveled to Meeting
- 61 ☐ Under 51 miles
- 62 ☐ 52 to 150 miles
- 63 ☐ 151 to 400 miles
- 64 ☐ 401 to 1000 miles
- 65 ☐ 1001 to 3000 miles
- 66 ☐ Over 3000 miles

Last AAAS Meeting Attended
- 71 ☐ 1972 in Washington
- 72 ☐ 1973 in Mexico City
- 73 ☐ 1974 in San Francisco
- 74 ☐ 1975 in New York
- 75 ☐ 1976 in Boston
- 76 ☐ 1977 in Denver

Hotel Reservations

Room Rates*

Annual Meeting
Washington
12-17 February 1978

The 144th National Meeting of the American Association for the Advancement of Science will be held in Washington, DC, 12–17 February 1978. Symposia, contributed paper sessions, and all other Meeting activities are scheduled in the Sheraton-Park (headquarters) and Shoreham Americana hotels. Both hotels will have AAAS registration and information desks and provide housing at the following convention rates:

Hotel	Single	Double	Twin	Suites**	Parking
SHERATON-PARK *(Headquarters)* 2660 Woodley Road, N.W. *(No. of rooms held: 1000)*	$32 35 38 40	$42 45 48 50	$42 45 48 50	$85 and up	$2.60 for daytime parking. $3.60 per 24 hrs. (*inquire at the Front Desk about in and out privileges*).
SHOREHAM AMERICANA 2500 Calvert Street, N.W. *(No. of rooms held: 600)*	$30	$40	$40	$70 and up	$3.00 per 24 hrs. (*with in and out privileges*).

STUDENT RATES: Both the SHERATON-PARK and SHOREHAM AMERICANA hotels have provided these special room rates for students:

Triple occupancy: $15 per person; **Quadruple occupancy:** $12 per person

Only prearranged groups of 3 or 4 students with the same arrival and departure dates qualify for these special rates. All names must appear on the Hotel Reservation Form.

*Per day; add 8% D.C. sales tax. Charge for additional person in room, $10; rollaway beds or cots, $10 (both hotels.) Children accommodated free in same room with parents: Sheraton-Park, age 18 and under; Shoreham-Americana, age 14 and under.

**Lowest available rate for one-bedroom/parlor suites; rates for larger suites available on request.

NOTE: If room rate specified is not available, the next available higher rate will be assigned. Confirmation will come to you directly from the hotel. Please make all reservation changes and cancellations through the Housing Bureau *in writing*. Room assignment will be delayed if any information is omitted from the Hotel Reservation Form.

HOTEL RESERVATION FORM

Please type or print

Reservations received after 20 January cannot be assured.
The Housing Bureau will not accept any reservations by telephone.

CHOICE OF HOTEL: First _____ Second _____

ROOM: ☐ Single ☐ Double ☐ Twin **SUITE:** ☐ 1 Bedroom ☐ 2 Bedrooms **PREFERRED RATE $** _____

STUDENTS: ☐ 3 persons per room ☐ 4 persons per room

Please indicate any special housing needs due to a handicap: _____

_____

ARRIVAL: Date _____ ; _____ a.m. _____ p.m.

DEPARTURE: Date _____ ; _____ a.m. _____ p.m.

Be sure to list definite arrival and departure date and time. Hotel reservations will be held only until 6 p.m. unless otherwise specified. Check out-time is 1:00 p.m. at both hotels.

NAMES AND ADDRESSES OF ALL OCCUPANTS OF ROOM

Name _____ Name _____

Address _____ Address _____

City _____ State _____ Zip _____ City _____ State _____ Zip _____

Name _____ Name _____

Address _____ Address _____

City _____ State _____ Zip _____ City _____ State _____ Zip _____

Hotel, confirm reservation to: _____

Mail to: AAAS Housing Bureau
1129 Twentieth Street, N.W., Washington, D.C. 20036