



## SCIENCE AND ENVIRONMENT

## Abelson Seminar: It's "Time for Microbes to Have Their Due"

A visitor to Earth during most of the planet's history would have been greeted only by microbes, and those ubiquitous organisms continue to help shape both the planet's destiny and ours, according to researchers who spoke at the Philip Hauge Abelson Advancing Science Seminar at AAAS.

"It's definitely time for microbes to have their due," said David Stahl, a professor of environmental engineering and science at the University of Washington. "We live on the planet of the microbes," he said, with very large numbers of those organisms controlling the key cycles of planetary chemistry that produce such essentials to life as oxygen and organic forms of carbon and nitrogen.

But in many cases, he said, scientists still don't know which populations of bugs are in control of specific cycles. There have been surprising discoveries just within the past few years. An anaerobic organism that digests ammonia, first described in 1999, represents a major part of the nitrogen cycle that had been missed during a century of investigation, according to Stahl. Another bug, discovered in 1992, accounts for about 20% of the bacterial component of the plankton that drifts in ocean waters.

Speakers at the symposium told how genomics, microbiology, mineralogy, geochemistry, and materials science have provided new insights on the history of microbes and their potential for such practical applications as cleaning up polluted sites, mitigating the effects of climate change, or producing electricity.

The 26 October seminar "Microbes, Minerals and the Environment" honored the late Philip Abelson, editor of *Science* for 22 years and then senior adviser to AAAS. He founded and sponsored the seminar series to encourage participants to think about where science is going, not where it has been.

"We're so lucky to work on a diverse group of organisms that we know so little about," said Anna-Louise Reysenbach, a professor of microbial biology at Portland State University who has been studying the heat-loving microbes found around hydrothermal vents,

seafloor geysers that spew superhot, mineral rich water. She showed an image of one organism, which she calls the "devilheterotrophentblob," whose cell wall had formed two horn-like structures. It turns out to be the first truly acid-loving microbe in the neighborhood of such hydrothermal vents.



Microbiologist Derek R. Lovley; human microbiota *Lactobacillus*, which produces lactic acid (right).



The durability and variety of microbes continue to astonish researchers. Keynote speaker Derek R. Lovley, a microbiologist at the University of Massachusetts, Amherst, mentioned Strain 121, a deep-sea organism discovered in 2003 that survives at 121°C (250°F). That is the highest temperature at which life is known to exist—equivalent to the heat in autoclaves used to sterilize surgical instruments.

Species of bacteria called *Geobacter* are of interest because of their novel abilities to transfer electrons. They can harvest electricity from aquatic environments and may prove useful as power sources for underwater monitoring instruments, Lovley said. It is likely that fuel cells can be made from pure cultures of *Geobacter* organisms, he added, perhaps initially to power electronic gadgets like cell phones.

There are other practical applications on the horizon, speakers said, including use of *Geobacter* species and other microbes to bind uranium, plutonium, and other metals in polluted groundwater or soils. Bruce Hungate, an ecologist at Northern Arizona University, offered a cautionary note, however, on one proposed "biological fix" for rising carbon dioxide levels in the atmosphere. While plants may

grow more in response to elevated carbon dioxide levels, Hungate said, microbes in the soil apparently have a reverse effect, limiting the amount of carbon that the soils can sequester.

Paul Falkowski, a professor in the Institute of Marine & Coastal Sciences and the Department of Geological Sciences at Rutgers University, was wary of human tinkering with natural cycles. "We are messing with something we don't really know much about," he said. "We have, in the last 150 to 200 years, so critically altered the carbon, phosphorus, sulfur, nitrogen, water cycles," Falkowski said, that society is on a path toward unsustainable development.

Falkowski urged reductions in carbon dioxide and sulfur emissions and in the use of nitrogen-containing fertilizers so that we can return to a world "where microbes basically are taking care of the cycles for us, because we cannot take care of the cycles for ourselves."

—Earl Lane

## EDUCATION

## Digital Architects Ponder the Library of the Future

The emergence of the Internet over the last decade as an everyday data and communication tool has created enormous possibilities in science education, but also inefficiencies and distractions. If you doubt it, go to your favorite Internet search engine and type in v-e-n-u-s.

What do you get? Not just the second planet from the Sun, but a line of women's clothing, the Roman goddess of love and beauty, and an e-zine about women in the arts.

For the past 11 years, the U.S. National Science Foundation (NSF) and a corps of visionaries funded by NSF have been building a library that sharpens the focus of the Internet and makes it an effective, efficient tool of 21st-century education for science, technology, engineering, and mathematics (STEM). It's called the National Science Digital Library (go to your search engine and type in n-s-d-l). Nearly 200 of the library's architects—including representatives from industry, major universities, and government—gathered at AAAS 18 to 20 October to consider its future.

"You know all the reports that are out now about the conditions of the STEM disciplines in the United States and how few kids are going into them, the whole pipeline issue," said Kaye Howe, executive director of NSDL Core Integration. "We would really like to be part of the solution on this, both by creating a community

and by giving that community the material, the tools, and the services it needs in order to master these very important areas that are sometimes difficult to master.”

Aside from providing services to the average science classroom, Howe said, the NSDL might be crucial in providing education support in poor states where textbooks are in short supply, or in areas like New Orleans where schools have been devastated by natural disasters. And, she said, it might provide a critical connection to science for a student who is otherwise bored and inclined to drift away from STEM fields.

Since the NSDL was conceived 11 years ago, NSF has funded over 200 related projects. Among them is the AAAS-managed BiosciEd-Net (BEN) portal, which offers more than 4500 reviewed resources covering 77 biological sciences topics.

“AAAS is involved with the NSDL because of its mission related to science literacy for all and increasing public understanding of science,” said Yolanda George, deputy director of Education and Human Resources at AAAS. “Also, the NSDL provides an opportunity for AAAS to work with its affiliated organizations to strengthen teaching and learning in the biological sciences.”

Before the Internet, a library was evaluated in part on the number of volumes on its shelves, Howe said. But with “the growth of information on the Internet, material itself was no longer scarce. What did begin to happen very quickly was that finding that material and finding material that you could trust, and use—that really became the great exercise.”

Today, the NSDL works as a more discerning version of Google. Type in v-e-n-u-s and you get nearly 2000 up-to-date resources about every aspect of Earth’s neighboring planet, all carefully reviewed by experts, suitable for students and teachers at various levels from kindergarten through undergraduate studies.

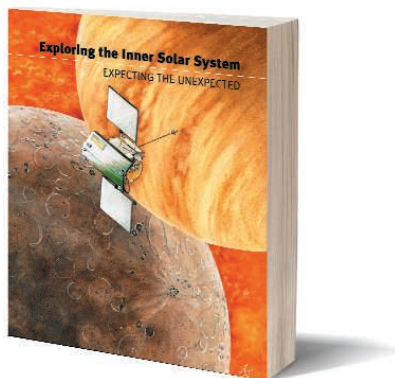
But behind that seemingly simple service is a stream of interests working to refine a futuristic science of collecting, storing, and distributing data. From a process of constant evaluation and reevaluation, NSF and the NSDL have developed a system of “pathways”—collaborative administration centers which oversee the collection, management, and organization of the material.

The BEN Collaborative is one such pathway. Founded in 1999 by AAAS with 11 other professional societies and coalitions, it has since grown to 25 partners. Educational e-resources from all the collaborators are aggregated into a one-stop, searchable catalog at the BEN portal. In 2005, BEN was awarded a 4-year, \$2.8-million NSF grant that would allow it to increase its collection to more than 27,000 scientific papers, illustrations, images, lab exercises, and other materials deemed helpful for teachers in the biological sciences.

## SPACE EXPLORATION

# AAAS, NASA Team Up on Solar System Book

With NASA’s MESSENGER spacecraft streaking past Venus on its way to Mercury, AAAS has joined with the space agency to publish *Exploring the Inner Solar System: Expecting the Unexpected*, a book designed to inspire student interest in space sciences.



The 72-page book, aimed at science educators and students, focuses on the Moon and the solar system’s four terrestrial planets: Mars, Earth, Venus, and Mercury. It features dozens of pictures and detailed discussion of both past missions and future expectations for MESSENGER, which is due to make its first Mercury flyby in January 2008.

“Millions of people, from professional scientists to science-engaged citizens, first got excited about science by following NASA space missions,” said Bob Hirshon, AAAS senior project director. “The MESSENGER mission to Mercury is a chance to excite a new generation of budding scientists.”

Mercury is the planet closest to the Sun; it is the hottest planet and it has the oldest surface. More than 35 years have passed since NASA’s Mariner 10 craft sent the most recent images of Mercury’s terrain. NASA hopes that MESSENGER will provide extraordinary images—along with new insights into how Earth was formed.

“We’re trying to put the MESSENGER mission to Mercury in a broader context by showing

how we reached our current understanding of the inner solar system,” said the book’s author, Justin Warner, who serves as a reporter for AAAS’s daily Science Update radio program.

*Exploring the Inner Solar System* is being distributed through the MESSENGER Educator Fellows program, an initiative training 30 science educators to conduct national outreach workshops on the mission. To date, NASA estimates over 3800 teachers have been trained by the Fellows.

As a key partner in the MESSENGER education and outreach campaign, AAAS also was asked to produce other education materials for the mission, including Web sites with engaging, game-like interactive modules for students and detailed lesson plans for teachers. K-12 teachers and other educators interested in receiving copies of the book should contact [bhirshon@aaas.org](mailto:bhirshon@aaas.org).

After three flybys, MESSENGER is scheduled to enter Mercury’s orbit in 2011.

—Benjamin Somers

## HUMAN RESOURCES

# Role Models with Disabilities Sought for AAAS Directory

Scientists and engineers with disabilities are invited to be listed in and to nominate others for inclusion in the AAAS Resource Directory of Scientists and Engineers with Disabilities. The fourth edition of the directory, now under development, will be used as a source of experts and role models for educators, journalists, and others.

Individuals with disabilities who hold graduate or undergraduate degrees in fields of science, technology, engineering, mathematics, social and behavioral sciences, or economics can submit a listing at <http://ehrweb.aaas.org/resource>. The directory will be available upon request in print and CD-ROM formats, but participants’ information will not be posted to the Internet.

The project is funded by the U.S. National Science Foundation. For more information, contact Tesa Leon at [tleon@aaas.org](mailto:tleon@aaas.org) or (202) 326-6582 (v/tdd).

## 2007 ELECTION

# A Call for Nominations

AAAS members may suggest nominees (including themselves) for president-elect and the Board of Directors for election in the fall of 2007. For a list of this year’s candidates, see AAAS News and Notes in the 28 July 2006 issue of *Science*; for a list of current Board members, see the masthead page of any recent issue of *Science*.

Please send the suggested nominee’s curriculum vitae no later than 30 December to Gretchen Seiler, AAAS Executive Office, 1200 New York Avenue, N.W., Washington, DC 20005. Suggested nominees will be considered by the AAAS Committee on Nominations at their winter meeting.

# AAAS Members Elected as Fellows

In October, the AAAS Council elected 449 members as Fellows of AAAS. These individuals will be recognized for their contributions to science and technology at the Fellows Forum to be held on 17 February 2007 during the AAAS Annual Meeting in San Francisco. The new Fellows will receive a certificate and a blue and gold rosette as a symbol of their distinguished accomplishments. Presented by section affiliation, they are:

## Section on Agriculture, Food, and Renewable Resources

Robert E. Davis, United States Department of Agriculture • Paul E. Fixen, Potash and Phosphate Institute • Jacqueline Fletcher, Oklahoma State University • David R. Gealy, United States Department of Agriculture • Robert L. Gilbertson, University of California, Davis • Tissa H. Illangasekare, Colorado School of Mines • Molly Jahn, Cornell University • Richard L. Lindroth, University of Wisconsin • Karen Ann Kuenzel Moldenhauer, University of Arkansas • Joseph G. Morse, University of California, Riverside • William A. Payne, Texas A&M University • Ian L. Pepper, University of Arizona • Pamela C. Ronald, University of California, Davis • Cynthia Rosenzweig, NASA Goddard Institute for Space Studies • Coby Schal, North Carolina State University • David Warren Stanley, United States Department of Agriculture • Chris van Kessel, University of California, Davis • Joachim von Braun, International Food Policy Research Institute

## Section on Anthropology

Marina Cords, Columbia University • Christine Ward Gailey, University of California, Riverside • Terry Harrison, New York University • Clark Spencer Larsen, Ohio State University • William Leonard, Northwestern University • Jonathan M. Marks, University of North Carolina at Charlotte • Margaret C. Nelson, Arizona State University • Alfred L. Rosenberger, Brooklyn College, CUNY • Margaret J. Schoeninger, University of California at San Diego • Jeffrey H. Schwartz, University of Pittsburgh • Elwyn Laverne Simons, Duke University • Olga Soffer, University of Illinois • Carol V. Ward, University of Missouri

## Section on Astronomy

Steven V. W. Beckwith, Space Telescope Science Institute • France A. Cordova, University of California, Riverside • Philip E. Kaaret, University of Iowa • Kwok-Yung Lo, National Radio Astronomy Observatory • Rosaly M. C. Lopes, Jet Propulsion Laboratory • David J. McCormas, Southwest Research Institute • William B. McKinnon, Washington University • Jean L. Turner, University of California, Los Angeles • William R. Ward, Southwest Research Institute

## Section on Atmospheric and Hydrospheric Sciences

Paulo Artaxo, Universidade Sao Paulo, Brazil • James Alexander Coakley Jr., Oregon State Uni-

versity • Franco Einaudi, NASA Goddard Space Flight Center • Michael C. Gregg, University of Washington • William R. Holland, National Center for Atmospheric Research • Eugenia Kalany, University of Maryland, College Park • Ray Franklin Weiss, University of California, San Diego • Hugh Edward Willoughby, Florida International University

## Section on Biological Sciences

Michael Edwin Akam, University of Cambridge • Robert R. H. Anholt, North Carolina State University • Barbara A. Baird, Cornell University • Dipak K. Banerjee, University of Puerto Rico • David A. Baum, University of Wisconsin • Stewart H. Berlocher, University of Illinois Urbana-Champaign • Katherine A. Borkovich, University of California, Riverside • George Timothy Bowden, Arizona Cancer Center • Wlodzimierz Marian Bujalowski, University of Texas • Sydney A. Cameron, University of Illinois, Urbana-Champaign • Akira Chiba, University of Illinois, Urbana-Champaign • Vincent L. Chiang, North Carolina State University • John S. Condeelis, Albert Einstein College of Medicine of Yeshiva University • William E. Conner, Wake Forest University • M. Fevzi Daldal, University of Pennsylvania • Julie Sloan Denslow, USDA Forestry Service • Shou-wei Ding, University of California, Riverside • Evan Eichler, University of Washington • Shelagh M. Ferguson-Miller, Michigan State University • Malcolm J. Fraser Jr., University of Notre Dame • James K. Fredrickson, Pacific Northwest National Laboratory • David Michael Geiser, Pennsylvania State University • Gregory C. Gibson, North Carolina State University • Pamela J. Green, Delaware Biotechnology Institute • Patrick L. Green, Ohio State University • Joanna Groden, Ohio State University • James R. Halpert, University of Texas • John J. Harada, University of California, Davis • Gerhard J. Haas, Fairleigh Dickinson University • Nyla A. Heerema, Ohio State University • Jodie S. Holt, University of California, Riverside • Barry Honig, Columbia University • Arthur Horwich, Yale University • Tim Hui-Ming Huang, Ohio State University • Barbara L. Illman, USDA Forest Service • John Jaenike, University of Rochester • Mark Johnson, Washington University • Barbara B. Kahn, Beth Israel Deaconess Medical Center • Leonard Katz, Kosan Biosciences, Inc. • Kenneth Keegstra, Michigan State University • Thomas J. Kelly, Sloan-Kettering Institute •

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side • Roberto Peccei, University of California, Los Angeles • Martin Perl, Stanford Linear Accelerator Center • Robert J. Perry, Ohio State University • Peter Pesic, St. Johns College • Jorge Pullin, Louisiana State University • Daniel Rugar, Almaden Research Center • Sashi Satpathy, University of Missouri • Arthur L. Smirl, University of Iowa • Antoinette J. Taylor, Los Alamos National Laboratory • John M. Tranquada, Brookhaven National Laboratory • Karl A. Van Bibber, Lawrence Livermore National Laboratory • Evgeny Pavlovich Velikhov, Russian Research Center "Kurchatov Institute" • Tassilo Andreas Reisenegger von Oepen, Pontificia Universidad Católica de Chile • Gwo-Ching Wang, Rensselaer Polytechnic Institute • William J. Weber, Pacific Northwest National Laboratory • Jory A. Yarmoff, University of California, Riverside

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#### **Section on Statistics**

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