

Young innovators  
and industry leaders  
finding solutions to  
tomorrow's challenges.



WARREN G. SCHLINGER SYMPOSIUM

14-15 SEPTEMBER

Chemical Heritage Foundation  
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Founded in 1849, Pfizer is the world's largest research-based pharmaceutical company taking new approaches to better health. We discover and develop innovative medicines to treat and help prevent disease for both people and animals. Through consistent, high-quality manufacturing and distribution operations, our medicines reach patients in

180 nations. We also partner with healthcare providers, governments and local communities around the world to expand access to our medicines and to provide better quality healthcare and health system support. At Pfizer, our colleagues work every day to help people stay happier and healthier longer and to reduce the human and economic burden of disease worldwide.



***Working together for a healthier world™***

## ABOUT INNOVATION DAY

The chemical industry faces many challenges and opportunities at the start of the 21st century, including the rapid emergence of new fields and the maturing of existing methods for research and manufacturing. Only a renewed focus on innovation will harness promising technologies and spur industry growth.

To promote early career innovation, the Chemical Heritage Foundation and the Society of Chemical Industry America International Group jointly organize an annual Innovation Day, consisting of the Warren G. Schlinger Symposium, the SCI Gordon E. Moore Medal, and the SCI Perkin Medal. The Schlinger Symposium brings together promising young scientists and technology leaders from across the chemical industries with a focus on frontiers of chemical R&D. Plenary and breakout sessions are oriented to areas where the chemical industry interfaces with other emerging business sectors. In combination with the medal ceremonies, the Schlinger Symposium offers participants the opportunity to learn about cutting-edge science and technology, exchange ideas with peer industrial researchers and entrepreneurs, and prepare to be innovation leaders.

## SPONSORING ORGANIZATIONS

### **About the Chemical Heritage Foundation**

The Chemical Heritage Foundation (CHF) fosters an understanding of chemistry's impact on society. An independent nonprofit organization, we strive to

- Inspire a passion for chemistry;
- Highlight chemistry's role in meeting current social challenges; and
- Preserve the story of chemistry across centuries.

CHF maintains major collections of instruments, fine art, photographs, papers, and books. We host conferences and lectures, support research, offer fellowships, and produce educational materials. Our museum and public programs explore subjects ranging from alchemy to nanotechnology.

### **About The Society Of Chemical Industry**

The Society of Chemical Industry is an international association that seeks to further the application of chemistry and related sciences for the public benefit. Headquartered in London since its founding in 1881, SCI has sections in the United States, Canada, Australia, Ireland, and India. Established in 1894, the American Section was the first society in the United States to bring together scientists and business leaders in industrial chemistry. The Perkin Medal was established in 1906 to commemorate the 50th anniversary of the discovery of mauveine. Past recipients include Nobel laureates Glenn T. Seaborg, Carl S. Marvel, and Herbert C. Brown; Donald F. Othmer, chemical engineer; Stephanie Kwolek, inventor of Kevlar; Paul S. Anderson, medicinal chemist, and Gordon E. Moore, the founder of Intel.

## PREMIER SPONSOR

### About the Schlinger Symposium

The Schlinger Symposium is named in honor of Warren G. Schlinger, a Ph.D. graduate of the California Institute of Technology with a distinguished career in industrial innovation. In Schlinger's 35 years at Texaco, he was a pioneer in gasification technologies now widely used for production of hydrogen, other chemicals, and power. Among other benchmarks, Schlinger had 15 U.S. patents issued during his career. He has been honored with the AIChE Technical Achievement Award, the Chemical Engineering Practice Award, and by the National Academy of Engineering.

## SCHEDULE

### 14 SEPTEMBER

- 3:30–5:30 p.m. **Innovation Day Pre-Session**  
*Franklin II, CHF Conference Center, 2nd Floor*
- Moderator: **Ron Reynolds**, Director of the Center for Contemporary History and Policy, Chemical Heritage Foundation
- Speakers: **Christopher L. Magee**, Director of the Center for Innovation in Product Development, Massachusetts Institute of Technology
- David Brock**, Senior Research Fellow, Center for Contemporary History and Policy, Chemical Heritage Foundation
- 6:00–7:00 p.m. **Opening Reception**  
*Jacobs Reading Room, 3rd Floor*
- 7:00–9:00 p.m. **Dinner and Address**  
*Ullyot Meeting Hall, 1st Floor*
- “Innovation in the Pharmaceutical Industry: A View Toward the Future”**
- John L. LaMattina**, Former President of R&D, Pfizer

### 15 SEPTEMBER

- 8:00 a.m. **Continental Breakfast**  
*Ullyot North, 1st Floor*
- 8:30–9:25 a.m. **Schlinger Symposium Opening Plenary**  
*Ullyot Meeting Hall, 1st Floor*
- “The Outlook for Energy and Technology Implications”**
- Michael C. Kerby**, Director, Chemical Sciences Laboratory, ExxonMobil Corporate Strategic Research

9:30–10:40 a.m. **Breakout Sessions: Presentations**  
*CHF Conference Center, 2nd Floor*

### **Sustainable Chemistry and Engineering**

Moderator: **Jody Roberts**, Program Manager, Environmental History and Policy, Center for Contemporary History and Policy, Chemical Heritage Foundation

Speakers: **Julie Zimmerman**, Assistant Professor, Yale University  
**Topher Buck**, Senior Project Manager, GreenBlue

### **Electronic Materials**

Moderator: **David Brock**, Senior Research Fellow, Center for Contemporary History and Policy, Chemical Heritage Foundation

Speakers: **Jane Frommer**, Researcher, IBM Almaden Research Center  
**Mike Nelson**, Vice President of Engineering, NanoInk, Inc.

### **Chemistry of Energy Sources**

Moderator: **Thomas Upton**, Research Manager, ExxonMobil

Speakers: **Michael H. Levy**, Director, Life Cycle Management Issues, Plastics Division, American Chemistry Council

**Clifford C. Walters**, Distinguished Research Chemist, ExxonMobil Research and Engineering Company

**M. Stanley Whittingham**, Director, Materials Science Program and Institute for Materials Research, State University of New York at Binghamton

**Ellen B. Stechel**, Manager, Emerging Energy Technologies, Energy and Infrastructure Futures Group, Sandia National Laboratories

### **Emerging Global Economies**

Moderator: **James Alder**, Vice President, Operations and Technical, Celanese Corporation

Speakers: **Cong Cao**, Senior Research Associate, Neil D. Levin Graduate Institute of International Relations and Commerce, State University of New York

Parmee joined Merck following a stellar graduate career at Oxford University and a NATO postdoctoral fellowship at the Massachusetts Institute of Technology. She has authored or coauthored 30 papers in refereed journals and is a coinventor on 24 issued and pending patent applications. First-rate medicinal chemistry skills and leadership abilities have made Parmee a well-respected and sought-out collaborator in the Merck research community, and her talents are also known worldwide.

## ABOUT THE SCI GORDON E. MOORE MEDAL

**The Society of Chemical Industry (SCI)** has established the SCI Gordon E. Moore Medal to recognize early-career success in innovation, as reflected both in market impact and improvement to quality of life. By highlighting extraordinary individuals and their work, SCI aims to promote public understanding of research and development in modern chemical industries, enhance the interest of students in applied chemistry by providing role models, and emphasize the role of creative research in the global economy. For more information, see SCI Gordon E. Moore Medal on the SCI Web site.

### **Past SCI Gordon E. Moore Medalists:**

Edmund M. Carnahan (2008)

Paul A. Sagel (2007)

Jonathan M. McConnachie (2006)

Jeffrey John Hale (2005)

George Barclay (2004)

# ABOUT THE 2009 SCI GORDON E. MOORE MEDALIST

**Emma Parmee** will receive the 2009 SCI Gordon E. Moore Medal for her key role in the discovery of the dipeptidyl peptidase-4 (DPP-4) inhibitor Januvia (sitagliptin), the first and only DPP-4 inhibitor approved for the treatment of type 2 diabetes.

Diabetes is a global epidemic affecting more than 240 million people worldwide. The incidence of this disease is growing at an alarming rate, with 380 million cases predicted by 2025. Each year over 3.8 million people die from complications of diabetes, including heart disease, stroke, and kidney failure. The vast majority of cases—90 to 95%—are type 2 diabetes, largely resulting from the increasing prevalence of obesity and sedentary lifestyles.

Despite the availability of a range of agents to treat type 2 diabetes, glucose control remains suboptimal, with less than 50% of patients achieving stated glycemic goals. In addition, current therapies have limited durability, and some are associated with significant side effects such as gastrointestinal intolerance, hypoglycemia, weight gain, lactic acidosis, and edema. Significant unmet medical needs remain; in particular, safer, better tolerated medications that provide increased efficacy and long-term durability are being sought.

Parmee and her colleagues' discovery of the selective DPP-4 inhibitor Januvia represents a major advance in the treatment of type 2 diabetes. Januvia provides glucose-lowering efficacy as monotherapy and in combination with metformin and PPAR agonists such as pioglitazone. Because of its unique glucose-dependent mechanism of action, there is very low risk of hypoglycemia. Overall side effects are comparable to placebo, and unlike many other anti-hyperglycemic agents, Januvia does not cause weight gain. DPP-4 inhibition is also associated with improvements in cell function, which may lead to increased long-term effectiveness. In October 2006 Januvia was approved in the United States as the first and only DPP-4 inhibitor for the treatment of type 2 diabetes.

**Steven C. Freilich**, Director of Materials Science and Engineering, DuPont Central Research and Development

**Marc Kalton**, Managing Director, Edica-Garnett Partners

## 10:45–11:40 a.m. **Morning Poster Session**

*Dow Public Square, 3rd Floor*

Moderator: **Ryan R. Dirkx**, Vice President of R&D, Arkema

## 11:45–1:45 p.m. **SCI Gordon E. Moore Medal Ceremony and Luncheon**

Gordon E. Moore Medal Lecture

*Ullyot Meeting Hall, 1st Floor*

**Emma Parmee**, Director, Medicinal Chemistry, Merck

## 2:00–3:10 p.m. **Breakout Sessions: Discussion**

Same topics as morning breakout sessions

*CHF Conference Center, 2nd Floor*

## 3:15–3:55 p.m. **Afternoon Poster Session**

*Dow Public Square, 3rd Floor*

Moderator: **Ryan R. Dirkx**, Vice President of R&D, Arkema

## 4:00–5:00 p.m. **Schlinger Symposium Closing Plenary**

*Ullyot Meeting Hall, 1st Floor*

**“Looking Back at Looking Forward: Mapping the Future of Chemistry”**

Speaker: **Alex Soojung-Kim Pang**, Associate Fellow, Saïd Business School, Oxford University

## 4:30–6:00 p.m. **Reception in Honor of Drs. Emma Parmee and Richard Silverman**

*Presidential Suite, Hyatt Regency Philadelphia at Penn's Landing*

## 6:00–10:00 p.m. **SCI Perkin Medal, Ceremony, Reception, and Dinner**

*Hyatt Regency Philadelphia at Penn's Landing*

**William Henry Perkin Medal Lecture**

**Richard B. Silverman**, Professor of Chemistry, Northwestern University

## ABOUT THE PLENARY SESSIONS

14 SEPTEMBER

### After-Dinner Talk

#### “Innovation in the Pharmaceutical Industry: A View Toward the Future”

Speaker: **John L. LaMattina**

The pharmaceutical industry is not often credited with innovation. That is largely believed to be the province of universities, research institutes and biotech. However, the development and application of new technologies has been critical in the pharmaceutical industry at every stage of the drug discovery-development continuum. From the earliest stages of this process, such as seeking a new chemical entity, to the design and execution of late-stage clinical studies, breakthroughs are needed to bring breakthrough medicines to patients. LaMattina will present examples of breakthroughs in studying heart disease, AIDS, and cancer.

## SCI GORDON E. MOORE MEDAL LUNCHEON

### ENTRÉE

Seared Jail Island Salmon Noodle Salad  
Asian Vegetables, Napa Cabbage, Sesame  
Tahini Dressing  
Selection of Rolls

### DESSERT

Chocolate Pot Au Crème, Raspberries,  
Whipped Cream

### BEVERAGES

Citrus and Strawberry Agua Fescas  
Selection of Freshly Brewed Iced Teas  
Coffee Service

from Oxford University. In 1972, he joined Exxon Research and Engineering Company to initiate a program in alternative energy production and storage. He discovered the role of intercalation in battery reactions, which led to the first commercial lithium rechargeable batteries. In 1978, he joined the State University of New York at Binghamton as a professor of chemistry to initiate an academic program in materials chemistry.

Whittingham was editor of the journal *Solid State Ionics* for 20 years, and he won the Battery Research Award of the Electrochemical Society in 2002. He is a fellow of the Electrochemical Society. In 2007 Whittingham cochaired the battery section of the U.S. Department of Energy Workshop on Energy Storage and presented its recommendations to the American Chemical Society and the Materials Research Society, as well as in the April 2008 issue of the *Materials Research Society Bulletin*.

**Julie Beth Zimmerman** is an assistant professor jointly appointed to the Department of Chemical Engineering, Environmental Engineering Program, and the School of Forestry and Environment at Yale University. She is also a visiting professor in the Department of Civil Engineering at the University of Virginia. Her research interests include green engineering, environmentally benign design and manufacturing, and the fate and impacts of anthropogenic compounds in the environment as well as appropriate water treatment technologies for the developing world.

Zimmerman previously served as an engineer and program coordinator in the Office of Research and Development at the United States Environmental Protection Agency, where she managed grants to academia and small businesses in the areas of pollution prevention and sustainability. She received a joint Ph.D. from the University of Michigan in environmental engineering and natural resource policy. Her thesis work focused on designing environmentally preferable machining fluids using renewable resources and evaluating their machining, environmental, and economic performance. Her policy research focused on exploring the government's role in enhancing industry's efforts to advance sustainability through the implementation of science and technology.

15 SEPTEMBER

### Opening Plenary

#### “The Outlook for Energy and Technology Implications”

Speaker: **Michael C. Kerby**

Biofuels derived from food crops are in conflict with nutritional needs of expanding populations. Even with non-food plants, land use and overall efficiency issues remain. ExxonMobil has announced an alliance with a leading biotech company, Synthetic Genomics, a privately held company located in La Jolla, California, to research and develop next-generation biofuels from photosynthetic algae. The partners believe that biofuel produced by algae could be a meaningful part of providing economically viable, low-net-carbon-emission transportation fuels. CO<sub>2</sub> utilized by the algae could provide greenhouse-gas-mitigation benefits. Algae do not rely on fresh water and arable land. ExxonMobil feels it can solve scale-up issues and process large volumes of the oils in existing refineries.

### Closing Plenary

#### “Looking Back at Looking Forward: Mapping the Future of Chemistry”

Speaker: **Alex Soojung-Kim Pang**

Alex Pang returns to Innovation Day after leading a workshop last year in which participants developed a roadmap that graphically depicted the critical factors that will drive research in the chemical industry over the next 20 to 40 years. Pang will present an updated version of the map and address new issues and opportunities that have emerged. He will also review the outputs from similar mapping projects conducted in other industries and other countries to enlarge the field of thought and provide new perspectives. The mapping process that Pang uses was developed by the Institute for the Future, a nonprofit research center based in Menlo Park, California, which specializes in long-term forecasting and quantitative futures research methods.

# ABOUT THE BREAKOUT SESSIONS

Each breakout will explore real-world challenges that can be solved through new materials, processes, or products from R&D labs in the chemical industry. The breakouts will seek to connect industry's innovation push to global-market pull. Each will focus on a specific issue, with speakers presenting perspectives based on their expertise and discussion groups dividing up to explore interdisciplinary methods for solving problems. Attendees can participate in one of these sessions.

## BREAKOUT 1

### **Sustainable Chemistry and Engineering**

As sustainability becomes an economic necessity, fundamentally new chemical transformations must be developed using green and sustainable chemistry and engineering to minimize environmental impact. Following the principle of "better to prevent waste than to clean up after it," researchers need to replace harmful solvents and improve catalytic selectivity and efficiency in chemical reactions that also provide cost savings. Presentations and discussion will explore issues of (molecular) design and engineering in the creation of more sustainable products.

responsibility for Energy and Environment in a number of Ford's university partnerships.

Stechel rejoined Sandia in 2005 to work on a Department of Homeland Security contract, developing strategies for technology transition. Stechel received a B.S. in mathematics and chemistry from Oberlin College and both an M.S. in physical chemistry and a Ph.D. in chemical physics from the University of Chicago. She has published more than 80 articles in refereed journals, and she has served as senior editor of the *ACS Journal of Physical Chemistry*.

**Clifford C. Walters** received bachelor's degrees in chemistry and biology from Boston University and a Ph.D. from the University of Maryland, where he conducted field and laboratory research on metasediments from Isua, Greenland, the oldest sedimentary rocks on Earth. He joined Gulf Research and Development in 1982, where he implemented a program in biological marker compounds. In 1984, he moved to Sun Exploration and Production Company, where he was responsible for technical service and establishing biomarker geochemistry and thermal modeling as routine exploration tools. Mobil's Dallas Research Lab hired Walters in 1988 to be supervisor of the Geochemical Laboratories.

Walters is currently a distinguished research chemist with ExxonMobil Research and Engineering Company, where he conducts work on the modeling of oil generation and reservoir transformations, geomicrobiology, and processes of solids formation. He has published numerous papers related to petroleum geochemistry, and coauthored a major treatise, *The Biomarker Guide*. He has served as editor of the ACS Geochemistry Division and is a current associate editor of *Organic Geochemistry*.

**M. Stanley Whittingham** is a professor of materials science and director of the Materials Science Program and Institute for Materials Research at the State University of New York at Binghamton. He received B.A. and Ph.D. degrees in chemistry

## BREAKOUT 2

**Mike Nelson** is senior vice president, engineering, at NanoInk. In this capacity, Nelson directs the science and engineering teams that develop hardware and software systems used for nanofabrication. In addition to new product design and development, he also manages several operational aspects of NanoInk's business, including manufacturing and information technology. Prior to joining NanoInk, Nelson was senior vice president, engineering, at Molecular Diagnostics, Inc.

Other previous assignments include vice president, systems development, for AccuMed International, director of technology for Caremark, director of systems engineering for Baxter International, and director of engineering for the Perkin-Elmer Corporation. He earned an M.S. in computer science and an MBA from DePaul University.

**Alex Soojung-Kim Pang** is an associate fellow at the Saïd Business School at Oxford University. As a futurist, he has written scenarios and created roadmaps on the emergence of new disciplines, the geography of innovation, and the impacts of technologies that act at (or define, or blur) the intersection of physical and digital worlds. As a historian, he has written *Empire and the Sun: Victorian Solar Eclipse Expeditions* and numerous articles for scholarly and popular publications.

Pang has worked as a research director at the Institute for the Future, managing editor of the *Encyclopaedia Britannica*, and an instructor at Williams College and the University of California, Davis. He holds a B.A. and a Ph.D. in history and sociology of science from the University of Pennsylvania.

**Ellen B. Stechel** is manager of emerging energy technologies in the Energy and Infrastructure Futures Group at Sandia National Laboratories and program manager of Sandia's Sunshine to Petrol project. Stechel joined Sandia in 1981 as a technical staff member in Condensed Matter Physics and became manager of Advanced Materials and Device Sciences in 1994. She worked at Ford Motor Company from 1998 to 2005, where she was the manager of chemistry and environmental sciences and had

### Electronic Materials

In some parts of the electronics sector, technical limits on materials engineering threaten to impede the development of new, faster, cheaper, more efficient products; while in other parts of the sector, novel materials are making possible dramatic new applications for untapped markets. Topics at the forefront of discussion include using miniaturized fuel cells to replace lithium-ion batteries; new alternatives or supplements to silicon; novel ceramics for heat management; and the use of techniques from microelectronics manufacturing for biomedical applications. Presentations and discussion in this session will focus on new developments in semiconductor processing and the challenges of innovating into new markets.

## BREAKOUT 3

### Chemistry of Energy Sources

With fossil fuel production at or near its peak, the chemical industry is intensifying its search for alternative energy sources that are more abundant, renewable, and environmentally friendly. Methods that show promise include fuel cells, hydrogen fuel, conventional and nanotechnology-enhanced solar systems, wind turbines, methane hydrate from the sea floor, and safer, less wasteful nuclear power. Meanwhile innovations that minimize waste from generation to transmission to consumption lead to more efficient energy use. Presentations and discussion in this session will focus on the innovative materials essential for new energy sources, especially solar energy, as well as business changes needed to alter our current energy infrastructure.

# BREAKOUT 4

## Emerging Global Economies

Globalization and the rapid growth of emerging economies present dramatic prospects for growth and diversification into new markets and new sites of innovation. China today boasts cutting-edge universities, world-class industrial research centers, and a string of technical institutes that cross the country and touch virtually every aspect of applied chemistry and materials science, from energy to construction to manufacturing process. Presentations and discussions in this session will focus on two examples of leading-edge academic and institutional research in China. The presenters will speak to the progress made in their areas of technology, their interactions across the technology arena, and the changes they have seen and foresee for technology in China.

Heroes of Chemistry award for work in the development and commercialization of the Nebula catalyst for producing cleaner diesel fuel.

**Michael H. Levy** serves as director, life-cycle-management issues, for the Plastics Division of the American Chemistry Council (ACC). He is also director of the Plastics Foodservice Packaging and the EPS Resin Suppliers Groups within the ACC. Prior to joining ACC, Levy held management positions with the Society of the Plastics Industry, Inc., and the American Forest and Paper Association. Levy has also held executive positions in private environmental, life-cycle analysis and waste-management firms as well as management roles in major petrochemical companies.

Levy's public-sector experience includes air enforcement and water-pollution-control responsibilities with the New York State Department of Environmental Conservation and highway design and construction responsibilities with the New York State Department of Transportation. Levy holds a graduate engineering degree from Rensselaer Polytechnic Institute. He also pursued an MBA degree at Fairleigh Dickinson University.

**Christopher L. Magee** is the director of the Center for Innovation in Product Development and a professor of the Practice of Engineering Systems and Mechanical Engineering at the Massachusetts Institute of Technology. Previously Magee spent 35 years at Ford Motor Company. His experience there ranged from early research and technology implementation work to later executive positions in Product Development, emphasizing vehicle systems and program initiation activities.

Magee has a Ph.D. in metallurgy and materials science from Carnegie Mellon University and a MBA from Michigan State University. His current research focuses on the innovation and change process in complex systems. His teaching subjects include product development, complex system modeling, and systems engineering. He has been a participant on major National Research Council Studies whose topics span design research to materials research. Magee is a member of the National Academy of Engineering and a Ford Technical Fellow.

## ABOUT THE POSTER SESSIONS

Frommer has written several seminal reviews and encyclopedia articles, published over 100 scientific articles, and was the founding editor of *Procedures in Scanning Probe Microscopies*. She serves in various capacities for the National Science Foundation and for the American Chemical Society. She is also a research mentor to numerous young scientists and is active in science outreach in local schools and community organizations.

**Marc Kalton** is managing director of Edica-Garnett Partners. He has over thirty years of industry and consulting experience. He focuses on globalization, strategy, and business development, including M&A and venture structuring. He has extensive North American, Asian and Latin American experience, including both B2B and B2C new-business development in these regions. His industry experience encompasses chemicals and energy, life sciences, food-safety diagnostics, retail, industrial products, automotive, and Asian outsourcing of both manufactured products and services.

Kalton is a former Arthur D. Little partner and market director for Asia-Pacific. His corporate experience was at Belco Petroleum and Union Carbide. He is on the board of directors of Isramco, Inc..

**Michael C. Kerby** received a B.S. in chemistry from the University of Dayton, a Ph.D. in inorganic chemistry from the University of Texas, Austin, and he performed post-doc research at the University of California, Berkeley. In 1989 he joined ExxonMobil's Process Development Laboratories in Baton Rouge, Louisiana. Over the past 20 years, he has held a number of technical and management positions within ExxonMobil Research & Engineering and ExxonMobil Refining and Supply Company.

Currently Kerby is director, Chemical Sciences Laboratory, ExxonMobil Corporate Strategic Research. He has 13 publications and holds 28 U.S. patents. Recently he was part of team that was recognized with the American Chemical Society's

We are grateful to those Innovation Day participants who have agreed to present posters highlighting innovative work in their laboratories or new products coming to market. These informal sessions allow all attendees to get a flavor for developments in the industry and establish networking relationships with their counterparts.

## POSTER PRESENTERS

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# BIOS

**David C. Brock** is a senior research fellow with the Center for Contemporary History and Policy at the Chemical Heritage Foundation. A historian of science and technology, Brock specializes in the history of semiconductor science, technology, and industry; the history of instrumentation; and oral history. He has studied the philosophy, sociology, and history of science at Brown University, the University of Edinburgh, and Princeton University.

His most recent publications are *Inventing the Digital World: A Documentary History of Fairchild Semiconductor from Startup to Microchip*, cowritten with Christophe Lécuyer, and *Understanding Moore's Law: Four Decades of Innovation*, which he edited and to which he contributed.

**Topher Buck** is a senior project manager at GreenBlue, where he manages the development of CleanGredients, a database of information on cleaning-product ingredients that support environmentally preferable product formulation. Over the last 15 years, Buck has worked with government agencies, private-sector firms, nonprofit organizations and academics in a wide variety of settings. His academic background and work experience comprise environmental chemistry, toxicology, ecology, energy systems, information design, and IT systems development.

Buck holds a bachelor's degree in chemistry and religious studies from Wesleyan University and a Master of Forest Science degree from the Yale School of Forestry and Environmental Studies. In addition he spent five years in the Ph.D. program at the Energy and Resources Group at the University of California, Berkeley.

**Cong Cao** is a senior research associate with the Neil D. Levin Graduate Institute of International Relations and Commerce, the State University of New York, where he also directs the Center for Science, Technology, and Innovation in China and coordinates the Global Talent Index project. He received an undergraduate education in chemistry in China and a Ph.D. in

sociology from Columbia University. He has worked at the University of Oregon and the National University of Singapore.

Cao is the author of *China's Scientific Elite* and *China's Emerging Technological Edge: Assessing the Role of High-End Talent* (with Denis Fred Simon).

**Steven C. Freilich** received a B.A. in chemistry from Amherst College and a Ph.D. in chemistry from Harvard University. He joined DuPont Central Research and Development (CR&D) in 1983 and was appointed research manager in 1987. He joined DuPont Titanium Technologies in 1994, where his roles included technical service manager, global business manager, and global technology manager for new business development. He returned to CR&D in 2004 as the director of materials science and engineering.

In addition to his current assignment, in 2008 Freilich was appointed chief technology officer of the DuPont Electronics and Communication Technologies Platform. He has served on the boards of the United States Display Consortium and DuPont Photonics Technologies. Currently he serves on the Materials Science & Technology Council External Review Panel for Sandia National Laboratory. He is also vice chair of the advisory panel for the Center for Revolutionary Solar Photoconversion.

**Jane Frommer** is a researcher at IBM's Almaden Research Center in San Jose, California. She received a B.S. in chemistry from Tufts University, with biochemical research at Massachusetts Institute of Technology and Mass General Hospital. After receiving a Ph.D. in organometallic chemistry from Caltech, she joined the nascent field of electronically conducting polymers at the Allied Corporation (now Honeywell), where she pioneered the solution state of electronic conductors. Her early involvement in scanning probe microscopies at IBM Research and at the University of Basel included the identification and manipulation of organic molecules by scanning tunneling microscopy and chemical species differentiation by atomic force microscopy.