HEI HEALTH EFFECTS INSTITUTE

update

SUMMER 2015

Conference Showcases HEI Science, Emerging Research Opportunities

Close to 200 scientists, institute sponsors, policymakers, and others from around the globe gathered in early May in Philadelphia, Pennsylvania, for HEI's 29th Annual Conference. The three-day meeting provided a welcome opportunity to attend interactive sessions featuring the latest research on air pollution and health and to meet others with similar interests.

This year's opening session, "Energy Choices," covered major trends in energy use and potential implications for health and climate. Sam Napolitano of the U.S. Energy Information Administration gave an overview of energy use and supply, current and projected. Maureen Cropper of the University of Maryland and Resources for the Future discussed the health benefits of controlling emissions from coal-fired power plants. Kirk Smith of the University of California–Berkeley presented efforts to reduce household air pollution in developing countries by introducing electric cookstoves and improved cooking practices. Drew Kodjak of the International Council on Clean Transportation spoke about vehicle efficiency and emissions standards and discussed new challenges, including discrepancies between results from laboratory emissions testing and from tests of on-road emissions, especially in Europe.

On Sunday night, speaker John Wall, vice president and chief technical officer of Cummins, Inc.,

Continued on page 2

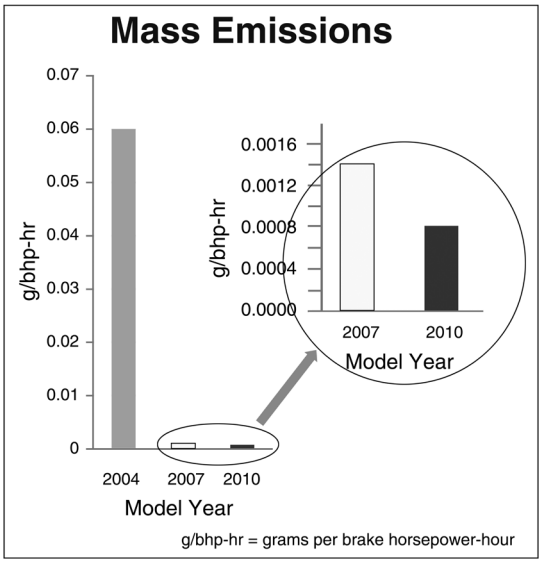
ACES New-Technology Diesel Results Highlighted

Executive Summary of Study Describes Significant Improvements in New Diesel Engines

This fall, HEI will issue the Executive Summary of the Advanced Collaborative Emissions Study (ACES), the synopsis and final publication from its program to characterize the emissions and assess the health effects of new-technology diesel exhaust (NTDE) from heavy-duty diesel engines that meet the 2007 and 2010 regulations enacted by the U.S. Environmental Protection Agency (EPA).

In view of concerns about the toxicity of old-technology, or "traditional," diesel emissions (TDE) on human health, government agencies in the United States and in other countries have adopted regulations to control them. In the latest of these actions, the EPA introduced regulations, effective 2007, to drastically lower particulate matter (PM) emissions and, effective 2010, to significantly lower nitrogen oxides (NO_x) emissions; these standards were expected to result in substantial public health benefits. To meet the new emissions limits, diesel-engine manufacturers developed new exhaust aftertreatment systems and the petroleum industry introduced new ultra-low-sulfur diesel fuel needed to allow the new emissions controls to work.

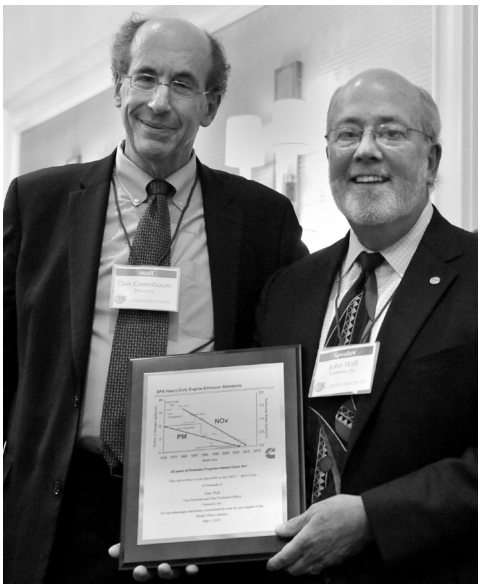
These regulatory and technological developments motivated HEI's industrial sponsors, the EPA, and other private and public groups to request HEI to conduct research to characterize emissions and health effects of NTDE. In response, HEI — in collaboration with the Coordinating Research Council, a nonprofit organization with extensive expertise in emissions characterization — launched ACES. The program's overall goals were (a) detailed characterization of NTDE from heavy heavy-duty diesel engines (such as those used in trucks and buses) compliant with the EPA's 2007 and 2010 regulations; and (b) assessment of health effects in rodents exposed to NTDE from a 2007-compliant engine (2010-compliant engines were not available at the beginning of the study).



Particulate matter emissions from old- and new-technology diesel engines (measured using Federal Test Procedure cycle).

Continued on page 4

Also in This Issue



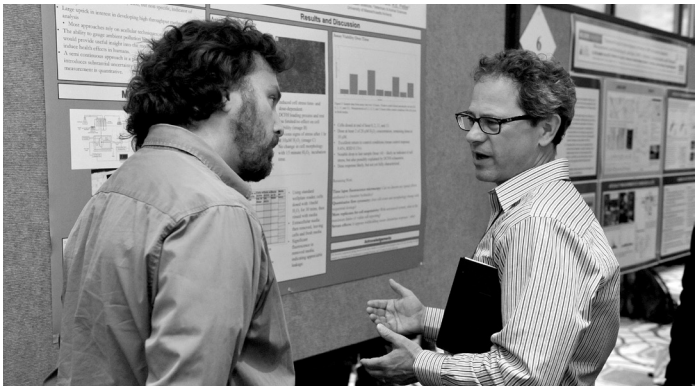
John Wall, vice president and chief technical officer of Cummins (right), receives a plaque from HEI President Dan Greenbaum inscribed with appreciation for his "35 years of Dramatic Progress toward Clean Air."

Current and past recipients of the Walter A. Rosenblith New Investigator Award, from left: Juana Maria Delgado-Saborit, University of Birmingham, United Kingdom; Richard Peltier, University of Massachusetts–Amherst; Nga Lee (Sally) Ng, Georgia Institute of Technology; Jason Surratt, University of North Carolina–Chapel Hill; Lydia Contreras, University of Texas–Austin; and Jun Wu, University of California–Irvine.

Maureen Cropper, University of Maryland and Resources for the Future.

Lydia Contreras, University of Texas–Austin, receives the Rosenblith award from David Eaton, University of Washington–Seattle and HEI Research Committee chair.

Geoffrey Sunshine, HEI, and Stephanie London, National Institute of Environmental Health Sciences and HEI Review Committee.



Richard Peltier, University of Massachusetts–Amherst (left), and Jeffrey Brook, Environment Canada and HEI Research Committee.

Carol Henry and Shirish Shimpi, both of Cummins, with luncheon keynote speaker Christopher Grundler (right), U.S. Environmental Protection Agency.

Annual Conference (*Continued from page 1*)

highlighted progress in technology to control vehicle emissions. HEI then honored Wall for his many contributions to this field and for his involvement with HEI from its inception in the early 1980s.

The annual "HEI Update" session on Monday morning included the presentation of the 2014 Walter A. Rosenblith New Investigator Award to Lydia Contreras of the University of Texas–Austin.

HEI Director of Science Rashid Shaikh presented highlights of the institute's major accomplishments over the past five years, such as completion of the Advanced Collaborative Emissions Study (ACES; see related story) and the National Particle Component Toxicity (NPACT) initiative, and spoke of the work ahead as described in the institute's Strategic Plan for 2015–2020. Next, Donna Vorhees

Continued on page 3

Leslie Edwards, U.S. Department of State, with Philip Bromberg, University of North Carolina–Chapel Hill.

Sougato Chatterjee of Johnson Matthey with Robert Harley, University of California–Berkeley.

Daniel Krewski, University of Ottawa, Canada, and chair of the HEI Diesel Epidemiology Panel.

Annual Conference (*Continued from page 2*)

of HEI provided an update on HEI's project to develop a strategic plan for research on the impacts of oil and gas development in the Appalachian Region and elsewhere (see related story). Finally, James Gauderman of the University of Southern California presented results from an HEI-funded accountability study based on data from three cohorts of the university's Children's Health Study. HEI Review Committee member Bert Brunekreef of the University of Utrecht, the Netherlands, presented the committee's comments.

Next, Katy Walker of HEI introduced a session to present the findings of the HEI Diesel Epidemiology Panel, which was charged with evaluating two recent epidemiologic studies of exposure to diesel exhaust and lung cancer for their potential use in quantitative risk assessment. The session highlighted issues such as the possible influence of exposure to tobacco smoke and radon as well as the challenges of constructing historical estimates of diesel exhaust exposure. Panel chair Daniel Krewski of the University of Ottawa, Canada, presented the Panel's conclusions regarding the uncertainties around these studies and the studies' potential for use in quantitative risk assessment. An active discussion between the audience and the Panel followed.

During lunch on Monday, Christopher Grundler, director of the Office of Transportation and Air Quality at the U.S. Environmental Protection Agency (EPA), provided a regulatory and historic perspective on transportation and air pollution, and presented a vision for the future.

The Monday afternoon session, "NO_2: New Insights on an Old Pollutant," was timely in light of the EPA's ongoing review of its Integrated Science Assessment. Jennifer Peel of Colorado State University examined a key question of whether nitrogen dioxide (NO_2) can be considered a marker for effects of traffic pollution or a pollutant on its own. Sougato Chatterjee of Johnson Matthey discussed current and future emission control systems for oxides of nitrogen (NO_x) and particulate matter (PM). Robert Harley of the University of California–Berkeley and David Carslaw of the University of York and Ricardo–AEA, United Kingdom, discussed near-road environments in California and London; both speakers noted the challenges of reducing ambient NO_2 concentrations, partly because of an increase in primary NO_2 owing to use of diesel particulate filters to meet standards for $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 μm or smaller).

The Tuesday morning session, "Air Pollution on Our Minds," examined the effects of air pollution on the brain — an emerging research area with potentially large public health implications. Tomás Guilarte of Columbia University presented possible mechanisms by which air pollutants may affect the brain. Jennifer Weuve of Rush University gave an overview of epidemiologic studies investigating dementia and discussed some key methodologic challenges, such as underreporting in data registries. Mònica Guxens of the Centre for Research in Environmental Epidemiology in Barcelona, Spain, addressed neurotoxic effects of air pollution during pregnancy and early childhood, including autism spectrum disorders.

The central theme in the final session, "Ultrafine Particles in a Multipollutant World," was how to design effective epidemiologic research to study long-term effects of ultrafine particles, which would fill an important research gap. Gerard Hoek of the University of Utrecht argued that short, mobile campaigns with monitoring at many sites was currently the most promising and cost-effective approach to estimate long-term ultrafine particle exposure. Allen Robinson of Carnegie Mellon University and the HEI Research Committee presented data about nucleation events — growth of small particles to larger particles through atmospheric processes — and their relevance to ultrafine particle exposure. Neelakshi Hudda of Tufts University and the University of California showed results from Los Angeles indicating that contributions of airports to ultrafine particle exposure in nearby communities is much larger than previously thought. Bart Ostro of the University of California–Davis presented results of the California Teachers Study, the only cohort study to date examining long-term effects of ultrafine and other particles. The session ended with a briefing from Beth Hassett-Sipple of the EPA about a recent workshop on the health effects of exposure to ultrafine particles and EPA's next steps on this topic. HEI

The final conference program and all presentation slides are available at www.healtheffects.org/annual.htm. Next year's Annual Conference is scheduled for May 1–3 in Denver, Colorado. Registration and program information will be available in early 2016.

CONFERENCE PHOTOS BY JAY MALLIN

Keen Interest Worldwide in ACES Findings

With all phases of HEI's Advanced Collaborative Emissions Study (ACES) now complete (see related story), HEI scientists have been sharing its results with diverse domestic and international audiences. Following release of the final results earlier this year, HEI staff briefed the U.S. Environmental Protection Agency's (EPA) Clean Air Act Advisory Committee in North Carolina and Washington, D.C., and in May, HEI was invited to present a summary of the findings to the Mid-Atlantic Regional Air Management Association, a nonprofit association of 10 state and local air pollution control agencies. Director of Science Rashid Shaikh, Principal Scientist Maria Costantini, and Senior Scientist Geoffrey Sunshine presented an hourlong webinar to more than 100 listeners from the mid-Atlantic region and elsewhere, summarizing the goals, key results, and conclusions of the study's three phases. Listeners from several fields called in with questions after the talk, showing the depth of interest in the study.

Several weeks later, Costantini presented the ACES results at the 19th ETH Conference on Combustion Generated Nanoparticles, held on June 28–July 1 at ETH Zentrum, Zürich, Switzerland. The presentation, to nearly 200 scientists, engineers, and regulators from Europe and the United States, first summarized the results of the study's characterization of emissions from engines compliant with EPA standards implemented in 2007 and 2010. Costantini then outlined results of the chronic bioassay in which rats were exposed lifelong to exhaust from a 2007-compliant engine so that investigators could evaluate tumor formation as well as respiratory, biochemical, and genotoxic end points.

Meanwhile, also in late June, HEI Vice President Bob O'Keefe presented the latest ACES results at the International Workshop on Vehicle Emissions Control in Beijing before an audience of government officials, vehicle industry representatives, and academics. In light of China's move toward ultra-low-sulfur diesel fuel, all in the audience were pleased to see the very positive ACES results showing reductions in diesel emissions and health effects that the fuel — and the technology it enables — can achieve.

ACES *(Continued from page 1)*

ACES was conducted in three phases. A team of researchers led by Imad Khalek at the Southwest Research Institute in San Antonio, Texas, used a special, rigorous 16-hour engine cycle to characterize NTDE from 2007-compliant heavy-duty diesel engines in Phase 1 and from 2010-compliant engines in Phase 2. The aftertreatment systems for the 2007-compliant engines included a diesel particulate filter; the 2010-compliant engines included the filter plus a selective catalytic reduction device. PM emissions from each of the four 2007-technology engines tested were significantly lower than the stringent 2007 PM emissions standards, which had already capped emissions at 90% below the previous standard. Similarly, the three 2010-technology engines tested had emissions levels well below the 2010 NO_x emission standard.

In Phase 3, Jacob McDonald and Joe Mauderly and their colleagues at the Lovelace Respiratory Research Institute in Albuquerque, New Mexico, exposed laboratory rats 80 hours a week for up to 30 months to three concentrations of NTDE from a 2007-compliant heavy-duty engine. In contrast to previous studies of long-term exposure of rats to TDE, the investigators found that lifetime exposure to NTDE did not induce tumors or precancerous changes in the lung and did not increase tumors related to NTDE in any other tissue. A few mild histologic changes were found in the lung; however, these were not precancerous lesions, as previously observed in long-term exposure studies of rats to TDE. Rather, the effects of NTDE more closely resembled changes noted in rats after long-term inhalation exposure to gaseous oxidant pollutants, particularly nitrogen dioxide — a component of NTDE in 2007-compliant engine emissions that has been reduced in 2010-compliant engines. In addition to evaluating NTDE for its carcinogenic potential, the ACES Phase 3 study also evaluated a large number of genetic, physiologic, and biochemical end points at Lovelace as well as at laboratories of other investigators; these tests did not exhibit any consistent, exposure-related effects.

HEI's goal in publishing an Executive Summary of its ACES program is to provide a comprehensive synopsis of the findings of all aspects of this important study in one place, written for a broad audience. The summary is expected to be available this fall on HEI's Web site at *pubs.healtheffects.org*.

Communicating Results

Greenbaum Lectures in London

In early June, HEI President Dan Greenbaum delivered the Annual Distinguished Guest Lecture at Imperial College for the MRC-PHE (Medical Research Council–Public Health England) Centre for Environment and Health, a partnership between Imperial College and King's College London. The lecture, to 150 scientists and policy experts, was titled "Science to Inform Decisions in the Developing World: Addressing the Air Quality Science and Policy Challenges in China and India." It reviewed the long and deep history of research into the health effects of exposure to air pollution in developed countries, especially in North America and Europe, and the extensive action to improve air quality that such research has prompted. Greenbaum then reviewed the scientific basis and challenges for estimating air pollution's health burden in developing countries such as China and India, the initial and varied responses in the two countries, and, looking ahead, the needs for additional science.

Estimating Pollution's Global Health Impact

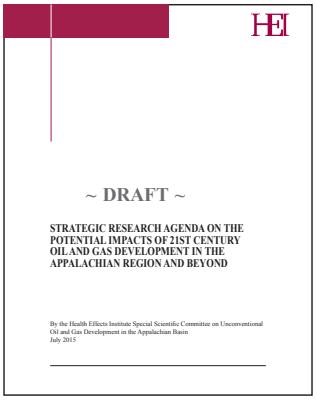
On May 24, HEI Principal Scientist Aaron Cohen presented the latest estimates from the Global Burden of Disease (GBD) collaboration at the Shanghai Forum, an annual event sponsored by Fudan University in Shanghai, China, and attended by hundreds of Chinese and international policymakers, business leaders, and scientific and technical experts. GBD, which involves the work of multiple institutions around the world, is a rigorously conducted, peer-reviewed analysis of major global health risks. The estimates from GBD 2013, which will be published this fall in the British medical journal *The Lancet,* indicate that ambient air pollution, or $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 µm or smaller), was the sixth leading global risk factor in 2013, contributing to 5% of total global deaths. In China, GBD 2013 estimates at the national and provincial levels show that ambient air pollution ranked fifth, after high blood pressure, tobacco smoking, and two dietary factors, as a cause of years of life lost in 2013, due largely to mortality from stroke and heart disease. Cohen also presented preliminary results of the Global Burden of Disease Major Air Pollution Sources project, or GBD MAPS (see *HEI Update,* Fall 2014), which will estimate the burden of disease in China, India, and Eastern Europe attributable to current emissions from coal burning and other major sources of $PM_{2.5}$ pollution.

Research Agenda Taking Shape

Panel Studying Impact of Oil and Gas Development Presents Draft Agenda at Public Workshop

An HEI special committee released a draft strategic agenda for research on the potential impacts of oil and gas development and presented it at a July 30 public workshop in Pittsburgh, Pennsylvania.

As reported earlier in *HEI Update* (Summer 2014), the institute has received special funding, entirely from private foundations, to develop a strategic agenda for guiding research to improve the understanding and prevention of potential adverse impacts of 21st century oil and gas development on human health and well-being, communities, ecosystems, and the environment of the Appalachian region and other areas. As used in the Strategic Agenda, "21st century oil and gas development" refers to the development and production of oil and natural gas as practiced today in the Appalachian basin, where, as in other places, industry practices continue to change in response to evolving technology, regulations, and other factors.


HEI

~ DRAFT ~

STRATEGIC RESEARCH AGENDA ON THE POTENTIAL IMPACTS OF 21ST CENTURY OIL AND GAS DEVELOPMENT IN THE APPALACHIAN REGION AND BEYOND

By the Health Effects Institute Special Scientific Committee on Unconventional Oil and Gas Development in the Appalachian Basin
July 2015

The special committee's draft report, *Strategic Research Agenda on the Potential Impacts of 21st Century Oil and Gas Development in the Appalachian Region and Beyond*, is the product of months of review by an interdisciplinary group of independent experts from across the United States. Their deliberations were informed by knowledge and guidance offered at two earlier public workshops in June and December of 2014. Participants at all three workshops included academic scientists, federal and state officials, representatives of industry working actively in the region, and leaders from nongovernmental organizations evaluating ecologic and human health issues.

The committee recognizes the widespread reports of benefits resulting from oil and gas activities, such as job growth in economically depressed areas and progress toward national energy security. It also recognizes that, ideally, decisions about where and how oil and gas development is permitted should be grounded in a clear scientific understanding of its potential advantages and potential impacts. Although the committee was charged with creating a strategic agenda to fill gaps in knowledge about potential adverse effects, it also considers the potential benefits to be worthy topics of research.

The draft strategic agenda includes research questions designed to help scientists characterize health stressors and understand how they might influence human and ecologic health, and to aid in the prevention of adverse impacts. The committee offers the draft strategic agenda as an impartial, constructive guide that can be used both by researchers and those who fund them and by regulators, the oil and gas industry, environmental organizations, public health experts, and other stakeholders to inform policy in this important arena. HEI

Comments on the draft agenda are welcome and can be submitted to Donna Vorhees (*dvorhees@healtheffects.org*) by August 26. Slides from workshop presentations and the draft research agenda are available at the HEI Web site.

HEI to Hire a Senior Staff Scientist

HEI is seeking an accomplished individual to serve as Senior Scientist. The incumbent will join a dynamic and experienced team, contribute to HEI's overall scientific activities, and become the scientific lead for key parts of the Institute's global health program. In recent years, HEI staff have played a prominent role in the assessment of the global burden of diseases from air pollution; HEI is currently extending this work to estimate the burden of disease attributable to major sources of air pollution in select countries (e.g., China and India). The incumbent will play a major role in these and other HEI international activities. The successful applicant will also have opportunities to participate in the broad range of HEI programs aimed at identifying and understanding important air pollution issues in the developed world. The candidate should have a Ph.D. or equivalent degree in epidemiology, biostatistics, or a similar discipline, with a focus on environmental health and risk assessment. The position announcement can be found at *www.healtheffects.org/jobopening.htm*. Applications and nominations may be sent to *HR@healtheffects.org*. HEI

Health Effects Institute

101 Federal Street, Suite 500
Boston, MA 02110-1817, USA
Phone: +1-617-488-2300
Fax: +1-617-488-2335
www.healtheffects.org

Richard F. Celeste, *Chair, Board of Directors*
Daniel S. Greenbaum, *President*

HEI is a nonprofit organization funded jointly by government and industry to research and evaluate the health effects of air pollution. An overview of HEI, information on its current research program, and all published HEI reports are available for downloading, free of charge, from the Web site.

Production Staff for *Update*:

Hilary Selby Polk, *Managing Editor*
Hope Green, *Editor*
Annemoon M.M. van Erp, *Webmaster*
Sarah Benckart, *Web Assistant*
Ruth E. Shaw, Cameographics, *Layout and Composition*

SIGN UP: HEI NEWSLETTER ONLINE

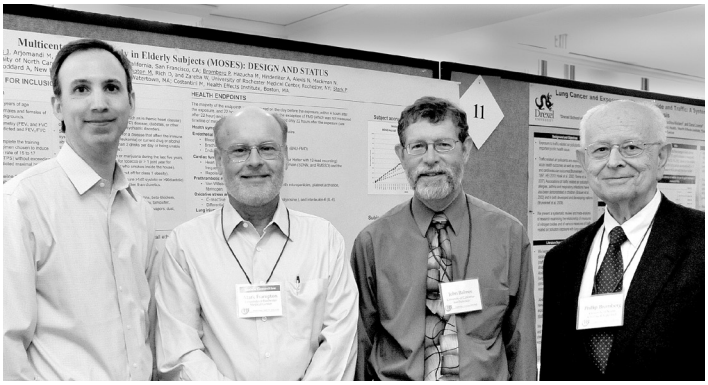
To sign up for free e-mail delivery of *HEI Update*, send a message to *pubs@healtheffects.org*, and we will add you to our e-subscribers mailing list. Let us know if you would also like to continue receiving the paper version.

Health Effects Institute
101 Federal Street, Suite 500
Boston, MA 02110-1817

Testing of Ozone Study Subjects Completed

Testing of subjects in HEI's Multicenter Ozone Study in Elderly Subjects (MOSES) was completed in April. This study is examining the effects of controlled exposures to low concentrations of ozone on the cardiovascular system in men and women 55 to 70 years old, an area that has gained increasing attention in recent years. Researchers are looking to see if ozone exposure has effects on autonomic balance, cardiovascular function, vascular function, and clotting variables.

The subjects were exposed to 70 and 120 parts per billion of ozone and clean air for 3 hours on separate visits at 3 clinical centers: University of California–San Francisco, University of North Carolina–Chapel Hill, and University of Rochester Medical Center. A total of 87 subjects completed all 3 exposures, which is very close to the number targeted at the start of the study (90 subjects). A fourth center, the New England Research Institutes, is responsible for data management and for the statistical analyses of the combined data sets. In May, MOSES investigators met in Philadelphia after the HEI Annual Conference to discuss the results and start writing the final report. The full analyses started this summer, after all the results were submitted from the core laboratories and the clinical centers, and after the core laboratories underwent a quality assurance audit. HEI



The MOSES principal investigators, from left: Paul Stark, New England Research Institutes; Mark Frampton, University of Rochester Medical Center and HEI Review Committee; John Balmes, University of California–San Francisco; and Philip Bromberg, University of North Carolina–Chapel Hill. PHOTO BY JAY MALLIN