

▶ Chemical sciences expand frontiers

The National Research Council weighs in on the challenges ahead for medicine and health.

BY ANN M. THAYER

After a few years of work, the National Research Council (NRC) has published a series of workshop reports on challenges for the chemical sciences in several areas of application. The reports continue a process begun nearly 40 years ago to highlight achievements, opportunities, and needs in chemistry and chemical engineering. Health and medicine are among the application areas, and the related report was presented during a recent American Chemical Society symposium in Anaheim.

The focused workshop reports and an initial broad-based report, *Beyond the Molecular Frontier: Challenges for Chemistry and Chemical Engineering* (2003, www.nap.edu/catalog/10633.html), assume that chemistry is the enabling science. According to the reports' champions, the discipline has occupied and will continue to play a critical role in national security, materials, information technology, energy, the environment, and medicine.

Beyond the Molecular Frontier poses "understanding fully the chemistry of life" as a leading challenge in health and medicine. Others include inventing and manufacturing effective antivirals and antibiotics; curing or preventing life-limiting diseases; improving drug delivery; developing new biomaterials; creating new diagnostics; and making organized chemical systems that mimic biological ones. The ACS symposium included presentations in some of these areas by leaders in the workshop process.

"We will understand life when we can put it all in chemical terms," said Ronald Breslow, Columbia University chemistry professor and former ACS president. Breslow participated in the health and med-

icine workshop and co-chaired the NRC parent committee with Matthew Tirrell, dean of engineering at the University of California, Santa Barbara.

"It's really true that we want to get to the point where everything can be explained and discussed in terms of the fundamental chemistry that's behind it," Breslow added. "Chemistry has a very important interface with biology, and [its] function is not just to be a tool for the study of biology, but to transform much of observational biology into chemical understanding."

Consistent with the other reports, the workshop report *Health and Medicine: Challenges for the Chemical Sciences in the 21st Century* (2004, www.nap.edu/books/0309087201/html) covers a series of common themes. These include identifying major discoveries or advances, identifying major challenges at the interface of chemistry and other disciplines, identifying grand challenges ahead, and identifying issues and opportunities related to infrastructure for research and education.

While the accomplishments listed in the *Health and Medicine* report are manifold, Breslow also highlighted some specific challenges. These include the need for advances in synthetic techniques, measurement, imaging, and nanotechnology, as well as reducing the cost of drug R&D. Infrastructure-related challenges involve sharing and handling information and data across disciplines, and providing an educational curriculum to support interdisciplinary research.

"This is a serious question," Breslow commented about education needs. "Very few chemists in fact learn about biology."

Some challenges are already being tackled, while others have not yet been addressed, Breslow noted. "At the end of the day, I believe that the contributions chemists have made to society and will continue to make in trying to solve these problems are probably the most important in terms of economic and health benefits," he told attendees. "Chemistry is where the action is and where it's going to continue to be, especially as we begin to work more at the biology and chemistry interface."

There were several general goals in generating the reports, explained Douglas Raber, who served on the NRC staff that helped put them together. "One is to serve the chemical sciences community by carrying out a self-examination and involving significant numbers of people in the process." This includes hundreds who participated in the workshops to write the reports, as well as audiences on the receiving end, such as that at the ACS meeting.

A second goal is to provide, with the reports, a mechanism for educating individuals outside the various disciplines covered. "There's a lot of reaching out to our colleagues here in other areas," Raber added.

There is also a desire to highlight that the chemical sciences underlie many areas of technology considered national priorities. And, last, a goal is to provide justification for the support of research and education, in large part by showing a linkage

between societal needs and basic research.

To advance these goals, Raber identified at least three key audiences: the chemical sciences community, other technically knowledgeable individuals, and decision- and policy-makers. Reaching this last group, however, may be the most difficult. And he called on chemists and chemical engineers to carry the message and make others aware of the reports. ■



Breslow



Raber