Le plus ça change … le plus c'est la même chose

Nicholas A. Peppas, a world leader in biomaterials, controlled drug delivery, and bionanotechnology, and the Fletcher Stuckey Pratt Chair in Engineering and Professor of Chemical Engineering, Biomedical Engineering, and Pharmacy at the Univ. of Texas at Austin, was selected as the 59th AIChE Institute Lecturer. He titled his talk "La plus ça change … Nanotechnology and Bioengineering in an Evolving Chemical Engineering World." In it, he pointed out how appropriate the quote, "Le plus ça change … le plus c'est la même chose," or "The more it changes, the more it stays the same," is, as AIChE begins its centennial celebration in 2008.

As early as the 1890s, the important coexistence of chemistry and biology was recognized, as noted in the 1894 annual report of the president and treasurer of MIT: "The courses in chemical engineering and sanitary engineering represent the demand for young engineers who shall have a fair knowledge of chemistry and biology in addition to their training as mechanical and civil engineers. The relations of the chemical and physical, and the chemical and biological departments are likewise becoming more intimate each year. Chemistry and biology occupy common ground in many matters related to hygiene, sanitation, fermentation, and like subjects."

Over the last 70 years, chemical engineering has evolved in response to changing and cumulative societal needs. Prior to 1950, in preparation for World War II and in its aftermath, the emphasis was on unit processes, unit operations and chemical kinetics. In the 1950s, improved living standards and well-being took center stage, and chemical engineers expanded into chemical reaction engineering, rheology, and fluid mechanics. In addressing the Cold War, space exploration, and military concerns in the 1960s and early 1970s, control and system synthesis became important topics. The need for pollution control in the early 1970s brought environmental engineering to the forefront, followed by energy crises (1970s and '80s) and the study of multi-phase and high-temperature reactions.

The mid-1980s ushered in the biotechnology and biomedical revolution, and chemical engineers began to look at biomaterials, medical systems, drug delivery, and tissue engineering. Developments in microelectronics, personal computers and communications made possible advancements in sensors, bioinformatics and metabolic engineering. And in the new millennium, the field of nanotechnology is taking off.

"These cumulative and increasingly global trends have driven chemical engineering from the macroscopic toward the microscopic … to the nano-scale … and will eventually lead it to molecular dimensions," Peppas said. As a result, in response to societal needs, chemical engineers are becoming increasingly involved in bioengineering and nanotechnology.

Chemical engineers have made numerous contributions to changing the treatment of illness and disease. For example,

Photo by Scott Butner

Peppas noted that chemistry, biology and engineering have allowed us to:

- obtain a genetic map of all individuals
- understand how diseases and genetic defects occur
- develop new chemicals, biomaterials and drugs to treat these diseases
- engineer delivery systems that will target drugs and genes to the correct tissues, cells or cell components
- non-invasively diagnose and treat patients
- create new replacement tissues and organs.

So, what does the future hold? Peppas discussed nanomedicine and the use of bioMEMS (microelectromechanical systems) devices as sensors; hydrogels as sensors; biomimetics, including intelligent biomimetic polymer networks and biomimetic imprinting; telemedicine using intelligent sensing and therapeutic systems; nanoparticles as drug-delivery devices, such as for the oral delivery of proteins; and more. System-responsive therapies based on these technologies promise a bright future (*CEP,* May 2007, p. 14).

Society continues to expect improved treatment of disease, advanced detection techniques and therapies, and cost-effective processes. These require advanced intelligent materials, more reliable devices, and miniaturized systems. Chemical engineers, Peppas asserts, are uniquely qualified to lead this charge. Our imaginations may be our only limits.

Peppas's pioneering contributions to chemical and biomedical engineering have received more than 28,000 citations, making him one of the most-cited chemical or biological scientists in the world. He has been recognized with numerous awards, and was elected a member of the National Academy of Engineering, the Academy of Medicine, Engineering and Science of Texas, and the Académie Nationale de Pharmacie (France). He is active in a variety of technical societies, including AIChE. He received a Dipl. Eng. from NTU Athens and a Sc.D. from MIT.