The biological sciences have undergone a revolution over the past several decades. According to Kelvin, biology is now a “Science,” characterized by prodigious amounts of quantitative data. This quantification of biology has spread into related fields, such as medicine and biomedical engineering, where improved technologies (such as magnetic resonance imaging and computed tomographic scanning) have drastically improved our ability to measure what goes on in the body.

It is natural that this biological revolution should join the other great revolution of the past several decades—namely, the advancement of computing technology. Computing is now so closely intertwined with modern bioengineering and biophysics that remembering when it was otherwise is difficult. Computing technology lets us manage the huge quantity of experimental data now available and build on that data through simulation. This work has led to the fields of bioinformatics and computational biology.

This special issue tries to convey the flavor of these intertwined fields. Of course, many possible examples exist of how computers are used in bioengineering and biophysics, but we have been able to explore only a few of them. At the molecular level, Jeffrey Skolnick and Andrzej Kolinski teach us how computational tools can help deduce the conformation of proteins from knowledge about their sequence. Such approaches will play a key role in the emerging science of proteomics, the systematic analysis of protein expression in normal and diseased tissue.

David Vorp, David Steinman, and I describe how computer simulation can work with advanced medical imaging technologies to help us understand the basis of arterial disease and how to plan the surgical treatment of such disease. This combined approach is a powerful way to gather critical information for understanding how arterial biomechanics can influence cellular function (and dysfunction) in arterial disease.

Leo Joskowicz and Russell Taylor usher us into the operating room of the future. Here, comput-
ing technology is not designed to help us understand the cause of disease but instead is focused on helping correct the problem or at least alleviate the symptoms. In the not too distant future, computers will routinely assist surgeons by helping with surgical planning. They will also extend the surgeon’s abilities to perform otherwise impossible tasks by overcoming inherent limitations in human manual dexterity and control. The impact on health care promises to be profound.

Biomedical engineers are charged with producing working products and processes for the biomedical industry, which is growing out of advances in biology, medicine, and engineering. In this dynamic and fast-growing field, educating young engineers with suitable cross-disciplinary breadth is a challenge. Norman Chonacky and Mitchell Litt describe real-world experience with computing technology integrated in a biomedical engineering learning environment. Their insights will be of interest to everyone who uses computers to teach.

My hope for this special issue is that it will stimulate interest in biomedical problems among computer professionals. We’re not lacking in challenging biomedical and biophysical problems that can benefit from computing. To tackle these problems, we need more people with strong computing backgrounds to work in the biological sciences.